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EDITORIAL NOTES.

The Governor's Survey—The Calorific Standard.

THE proceedings at the meeting of the Gaslight and Coke Company on Friday were of by no means a ponderous character. There was really not much of general interest for the Governor (Sir Corbet Woodall) to dwell upon at any length; for the leading features of the results of the half year's working and trading, as our review last week of the Directors' report and the accounts indicated, are, notwithstanding the massive character of the figures, few and concentrated. They can be summed-up on the fingers of one hand—cost of raw material, an excellent increase of gas business, enlarged custom, and a substantially increased return from residuals, to which last-named feature, of course, there were sets-off apart from the abnormally distended coal prices. But the uncomfortable element on the one side of the revenue account about found its counterpoise in the extremely comforting elements on the credit side; and consequently the proprietors saw excellent reason for allowing their satisfaction to remain at the normal level of the past few years, and to be thankful for the character of business and working and administration that had brought about this happy issue in the time of an immense burden. This burden is to be heavier still in the twelve months upon which we have entered, to (for the Company) the estimated amount of £170,000; and oil does not give any sign of easier conditions, so that it must continue to be largely ruled-out from the manufacturing operations.

Still the Governor is confident; and there is no need for alarm on the part of the proprietors in the circumstance of the unprecedented financial strength of the Company. True it is that the Company must not expect any great addition to the present excellent returns from residuals. That is, in fact, one of the most uncertain—we were almost writing "speculative"—quarters in the situation in prospecting regarding the future. The obstacle of oil prices to the relief of the coke market of a considerable amount of that residual is one of the disadvantages of the conditions of the times; but it is interesting to have the public announcement with regard to the London and Suburban Gas Companies now acting in concert in the excellent work of attempting to further cultivate the domestic and industrial home markets for it. It is hoped, not only for their own interests but for those of others, that they will be successful; for there are many gas undertakings beyond the limits of Greater London that do not like to see London coke stocks upward bound. However, the Governor is so hopeful in respect of the residuals markets, that he only looks upon the abnormal price of coal as the one blot on the prospect; and, being abnormal, he thinks that there will be an easing-off of prices before the next contract season comes round. That his hope may be fulfilled will be the ardent wish of all in the gas industry. If his scanning of the future by the aid of present developed information proves true, there will soon be a return to the practice of reducing charges to gas consumers, accompanied by an increase of dividend to the proprietors, and an advance of the amount divisible among the co-partners. Such a position is one the gas industry generally will hope to see attained by the Gaslight Company; for their improved position in this regard will reflect, practically speaking, the general experience in proportion to individual capacity. It was good to hear the optimistic views from the chair of the premier Gas Company, although no other interpretation could be given by any sentient and informed being to the portents of the times.

Avoiding the comparative figures relating to the Company's working of which we gave a number last week, there were some miscellaneous points in the Governor's address which have marked interest as showing the financial solidity that a wise statesmanship has been able during the past decade to construct about the Company. The much lower price of gas, the higher dividends, the stake that the workers now have in the enterprise, are all factors of fundamental importance in that solidity. But lay proprietors are apt to look in other directions for the evidences of the protection given to their investments by financial conditions. If they compare the present with the past, they will find something highly gratifying in the existing concrete financial state. A remarkable reduction has been rapidly made in the ratio of capital employed to the gas business done. Whereas ten years ago it was £675 per million cubic feet of gas sold, to-day it stands at £550 per million. The Gaslight and Coke Company have a long record of heavy capital burden, due in large part to past circumstances beyond administrative control. But no particular effort was made to reduce this burden till the more recent years; and now it has been and is being reduced, owing in part to Parliament ordaining moderate provision for the purpose of wiping-out unrepresented capital, but chiefly due to the prudent dealings of the Board in respect of depreciation and renewals, combined with the growth of the productive value and use of the plant. As a result, the charge for interest and dividend per unit of output has been greatly diminished. This is one direction in which the proprietors naturally look for stability; and another is to the amount of the accumulated funds. The proprietors are happy in the knowledge that, as stated by the Governor on Friday, the accumulated moneys, exclusive of reserve and depreciation funds, now exceed a million sterling. There is backbone there. But from this point of accumulated reserves, Sir Corbet drew a live, but at the same time melancholy, illustration as to the depreciation of investments of the "gilt-"edged" description. Upon purchases made since 1906, the interest received amounts to £61,906; while the depreciation has been £62,453. Thus the depreciation has been greater than the interest received! Well may the Governor say that the Company would have been better off if the Directors had adopted the tactics of the slothful servant, and buried this "talent;" for the original investment would have been of greater value than the present market price *plus* the interest received since the investment was made. Irrespective of this, however, it is seen that the financial position of the Company is to-day of unprecedented strength. Had it been otherwise, and had the old immobility in commercial matters continued, the Company would never have weathered in such a remarkable way as they have done the conditions of the past twelve months.

There is only one other matter to which allusion need be made in relation to the Governor's address. That is his announcement that the Board are considering the question of applying to Parliament for a calorific standard only. It has been obvious, from the time the Company were placed under a dual standard, that this must come about; for from the first they have felt the trammelling influence of the double standard of quality. It has come to the point when they are considering the question of relief from working to a standard that can serve no useful purpose with the need for it extinct. This announcement, at any rate, partly shows that we were near the truth in the meaning that was attached by us to Sir Corbet's somewhat cryptic references, at the Jubilee Meeting of the Institution of Gas Engineers, to a hope that some important movement would be made in the next session of Parliament in the matter of changing from the illuminating power standard to the calorific value one. Probably before the time comes for a full revelation as to the gas legislative movements next session, there may be a development of this matter beyond that which Sir Corbet's words convey. The time has long passed for preserving something that has no use, and which cannot even claim that there is an interest gathered about it which justifies the protection of its existence among other forms of antiquity.

Efficiency of Gas-Using Appliances.

Among the developments which all truly concerned with the interests and future of the gas industry are pleased to see is the extending abandonment of the old methods—the lowest tender, or personal favour, or perhaps in some cases a shareholding interest in a manufacturing concern—that decided purchase of gas appliances. That such conditions should ever exist, or should be the dominating ones in the settlement of dealings, is a matter to be deeply deplored, as they are not in consonance with the factors that make for activity in the development of the best characteristics in the appliances themselves, and which give to the gas undertakings a greater hold over their patrons by these obtaining from the appliances the maximum efficiency. Purchase and dealings with efficiency as the prime factor, according to the order of goods required, is the best possible incentive to manufacturers to employ the best means at command to produce appliances which will give the highest results; and the gas industry must, consistent with other considerations, defend that incentive as a factor in its future stability. This is more essential than ever to-day with competition on every side—competition that is ever active in trying to find fresh means of taking from the gas industry that which it has won in the past and is winning in the present. Therefore, we are glad to know that the managements of many gas undertakings have recognized the importance of testing "at home" appliances offered to them for their acceptance, and are now purchasing, more than ever was the case, on the basis of efficiency, which is the intrinsic value of the appliances, and not on other considerations that ruled so largely in the past. This being so, the time has come to consider this question of efficiency, and how far it is wise to carry it.

Efficiency must not be considered in any narrow manner; for it may be that, taking efficiency alone as a test of merit when appliances are in a new condition, those very efficient appliances may bring into disrepute both gas and the undertaking supplying it. Some other factors must be considered. Speaking generally, and excepting perhaps the gas-engine, gas-using appliances are of anything but of a complex order. Simpler appliances there could hardly be; and most of them can be tested for their ratio of useful work to the energy expended on a practical, as opposed to a theoretical, standard. This, of course, is the primary thing to which one must look, and which one must ascertain; but there are gas undertakings that make it the only thing, and against this there should be warning. While efficiency must stand at the head and front, other considerations must also be taken into account. Capacity for resisting wear and tear must not be overlooked. This is an essential to a comfortable existence as between gas supplier and consumer, as well as to a good financial condition in relation to any class of appliances, and a perpetuity of custom in that line. The electrical industry has already discovered this in connection with their cooking campaign. The most flimsily constructed electric-cookers give a high efficiency at the start; but with them, under the rough wear and tear of the kitchen, there is soon more vexation of soul and permanent discontent created, than there would be with a somewhat lower efficiency, and a high wearing and life efficiency. We have experimented with some inverted gas-burners that have given a high efficiency at the commencement of their life-work; but their careers have been very short before they have developed some defect. The burners have been of low initial price; their initial price and cost of replacement after a limited life have together meant more than would have been the case with a rather higher priced burner with an efficiency equal to, though perhaps not in excess of, at the beginning, the lower priced ones. The recent controversy on gas-fire efficiencies has proved the folly of merely considering, when purchasing, useful heating effect in relation to the heat-energy expended, without taking into account the highest attainable hygienic efficiency, which gives so much additional scope in fixing, and removes from the length of flue-pipe attached to the fire the responsibility of securing complete hygienic efficiency. In placing reliance upon the flue-pipe, there is always the danger that the proper length will not be fixed. In connection with gas-cookers, too, the question of heat efficiency has not been greatly studied, beyond the limited aspect of efficiency as expressed by the capacity of a cooker for doing a certain amount of work for a given consumption of gas.

There are the—to the industry, highly important—gas-heated water-circulating boilers. This is a comparatively new and developing business; and the utmost caution is required in its development, in making a good selection of apparatus. A high heating efficiency is imperative. It is necessary that there should be a transfer of as many heat units into the water as can be realized, and as little dissipation of heat as possible. But heating efficiency must not stand alone. These appliances will be subject to hard wear and tear, and more and more so as their convenience is experienced by their users. Therefore, side by side with heating efficiency, durability must be considered, as well as the suitability of the metal of which the boilers are constructed for the character of the water of the locality in which they are to be used. Whether the form of construction is correct for efficiency, the test for efficiency itself can be left to determine; but whether the construction is correct for durability, an efficiency test on a new appliance cannot possibly show. The interiors of some of the early (we will not speak of the relative merits of those on the market to-day) types of water-circulating boilers did not give promise of very long life. Material seemed to have been sacrificed to obtain a rapid transmission of heat to the water. In a test with a new boiler this condition would naturally give a high result in work done in relation to the expenditure of heat energy—in other words, consumption of gas. But the time would come, and that at a no distant date, when trouble would arise, and the user obtain a taste of the inconvenience which engenders discontent. When appliances of this kind are placed in the houses of gas consumers, for use by the members of the household as and when required, they are subjected to a variety of treatment, and yet are largely removed (they may, and they may not, receive intermittent inspection) from the sight and care of the representatives of the gas undertakings; and we all know what this means by the widely diverging experiences derived from different households.

It is unnecessary to dilate on the point further. But we know that the matter of the efficiency of gas appliances is being, and properly so, taken up with enthusiasm by some gas undertakings, and that orders are now being given in certain instances upon the results of such tests. We also know, however, that there is need for a little caution in a few directions. Care must be taken not, by too great reliance on illuminating or heating efficiency whatever the type or purpose of the appliance, to press the manufacturers to work solely to attain a high efficiency to the detriment of other qualities. In the long run, it is sometimes wise to give up a little of the thing most desirable to obtain, in order to secure other valuable inherent attributes. A very high efficiency and a very short life are not so good in gas appliances for the houses of customers as a somewhat lower efficiency and a reasonably long life, free from worry and disappointment. The ideal is, of course, the highest efficiency and the longest life; but there is a point in the relationship of efficiency and life that constitutes the thing that is most desirable and serviceable. It is this point that has to be sought in making selection and purchase.

Salutary Fines for Gas Strikers.

In Australia they have a more drastic, and up to a point a more effective, way than we have at home of dealing with labour conspiracies for disorganizing the necessaries and the conveniences of daily life; and there workers who combine in refusing to comply with the law and the decisions of the machinery set up by the Government for determining labour grievances are made to learn, in an effectual manner, that rebellion against constitutional methods merits, and must receive, punishment. Illustration is found in the fines inflicted on a hundred of the men of the Australian Gaslight Company who were prominently concerned in the strike in Sydney at the end of February and the beginning of March last. Altogether some 2000 men were involved in the stoppage. Sydney suffered grievously during the stoppage, but not so much so as the citizens and their industries would have done had not the Company been supported by a loyal staff and some of the rank-and-file, as well as by a goodly and energetic band of volunteers. The Company and the citizens generally were made the victims of an act that was an outrage on an honourably-drawn compact. In other words, the men were working under an agreement to which they were, through their Union, parties on the one side, and the Company on the other. The operative term of the agreement was some distance from its end, when the men conceived the idea that they were entitled to more pay than

that for which they had bargained. They petitioned the Court of Industrial Arbitration to appoint a Wages Board to consider their assumed grievance; but the Court rightly held that a Board would be of no avail while an industrial agreement was in force, which instrument could not be cancelled or overridden before its natural termination, except by mutual consent. This was a commonsense decision. But the men thereupon struck work; and Sydney felt itself partially paralyzed through want of the light, heat, and power that the Company had theretofore so reliably provided for them. The value of the gas supply had never been realized so much as during the days of deprivation. The trouble was eventually bridged-over by the promise of amending legislation, to allow a Board to consider the preferred grievance of the men. This decision, however, did not exculpate those who had been prominent in bringing about the catastrophe, and injury to the life and work of the capital city; and the hundred men were summoned. The defence put forward was that what had been done was not a strike for increased wages, but a cessation of work as a protest against the rejection of the request for the appointment of a Board to consider the demand for higher wages. The hollowness of the defence, in view of the existence of the agreement which was violated, and which should have honourably stood above all else, brought from Mr. Justice Heydon, a measure of well-deserved censure. The law and a valid agreement had been broken; and fines were inflicted with costs that, in the case of the hundred men, represent an aggregate sum of upwards of £900, which, it is believed, will come from the funds of their union, but which the Company or any other employers of these men are ordered to deduct from their wages.

These are the simple facts; and we are gratified to know that the authorities determined to see the law vindicated. There can be no defence in a matter of this kind for breaking the law; and in such a case the law ought not to step on one side, and allow those who are guilty of infraction to go unpunished. There has been in our own country too much of this breaking by employees of industrial agreements or contracts entered into mutually; and it has had disastrous results by causing the suspension of a more or less large part of the vitality of the country. But a singular thing is that the authorities here hesitate to exercise their power to bring the prime-moving delinquents to justice. Australia gives this country a lead in right methods of dealing with those who foment strikes and urge the violation of agreements. That country takes effective measures, while the authorities at home, knowing how to act, usually decline to do so, because of what?—the consequences! thus tacitly admitting what should never be admitted in a well-governed country that the law-breakers on the side of the employees in the industrial world are stronger than the law itself. It is a pitiful confession.

But there is another aspect of this matter which is to be deeply regretted; and it is that labour should treat with so much contempt the very contractual instruments that it assists in creating for reciprocal benefit. We cannot help thinking that militant unionism is largely responsible for this, by inciting and encouraging men to break agreements the due fulfilment of which rests upon the honour of both parties to them. One reason we think this is so is that where industrial contracts exist between workers under the flag of that form of unionism known as co-partnership, there is never any indication of any such dishonourable act as the concerted breaking of a contract by the whole body of workers. There we have the realization of a responsibility that is not found in those particular labour camps that, under the influence of the agitators of militant unions, trample under foot uprightness and fair-dealing, in order to gain ends in excess of those for which they have bargained for a period. How to cultivate generally among labour that sense of responsibility is a salient problem of to-day. It can only be done in one of two ways—the way of co-partnership that so many gas companies have found beneficial and effectual in this country, or by the means taken in Australia of inflicting punishment for disobedience to the law. We prefer the former way; but in other industries adoption of the plan is slow. In its absence, however, we like the commonsense firmness of Australian government—more especially in connection with industries which supply the necessaries and conveniences of life. No man ought to enter into the occupation of a position high or low in an industry or system upon which the public has to rely, and the stoppage of which creates any disorganization of public requirements, without he intends to always acknowledge a responsibility not only to his employers, but to the public, quite apart from his own self-interest. When labour acknowledges this, and acts accordingly, a better state of things will exist in the industrial world. The problem is how to educate employees to a higher recognition of their obligations—not only to themselves and to their families, but to others. The only secure way that has yet been discovered has been by breaking down the incomplete and incompetent principles that have hitherto governed the relations of capital and labour, and substituting the higher influences of co-partnership, which tend to remodel the understanding of the moral laws, and to raise the standard of individual responsibility. Anything that can command a really conscientious fulfilment of obligations on the part of workers without the aid of a country's law is a national advance and benefit.

Internal Cooling of Gas-Engines.

ALTHOUGH the idea is not new, the work that Professor Bertram Hopkinson has been doing on the internal cooling of the cylinders of gas-engines opens up the prospect of more economical and less weighty construction of engines of the larger powers. He described his work in a paper read before the Institution of Mechanical Engineers, meeting at Cambridge last week. The investigations that have of late years been made to determine the heat losses at different parts of the stroke have proved, as Mr. Dugald Clerk recently pointed out, conclusively that in an ordinary engine the rate of heat flow at the combustion chamber end, per unit of time and surface, is often more than six times that prevailing at the other end of the stroke. This being so, it clearly directs to simplified engine construction, dispensing entirely with complicated castings and double walls, by having recourse to interior cooling by means of water. In his paper, Professor Hopkinson shows how he has accomplished internal cooling, and in a manner to obviate what, without care, would be serious disadvantages. To attain the end he has experimentally proved to be possible, was worth striving for in the promotion of the economy of the gas-engine. When it is learned that no less than 30 per cent. of the heat value of the hot gases passes into the metal of the engines, the difficulty of the problem is at once apparent. And it has been but indifferently met in engines of the larger capacity by external cooling, which has meant the provision of a water-jacket, and of the elaborate appliances necessary for the circulation of water in the piston and exhaust-valve. This provision has not only meant more weight and cost, but it has added to the seats of trouble in an engine. Indeed, Professor Hopkinson asserts that external water cooling is the ultimate cause of most of the disadvantages under which the gas-engine has hitherto been labouring. With the present system of external cooling, unequal expansion is caused through the inequalities of temperature; and the overheating of certain parts of the inner surface of the cylinder is apt to cause pre-ignition of the charge. Therefore, from all points of view, to get rid of a process accompanied by uneconomy and the disadvantages mentioned, was certainly worth a great deal of effort; and we hope that working experience will confirm Professor Hopkinson's experimental experience. By the method of internal cooling described in the paper, the constructional economy appears to be well on the high road to realization; and the troubles alluded to promise to be averted, through the maintenance of equal temperature over the inner surface of the cylinder. Care must, however, be exercised in order that the cylinder walls may not be injured by corrosion, and that the lubrication is not washed out by the water. Naturally, too, clean and chemically suitable water must be used, in order to prevent deposition on the inner surfaces. All these points, it is clear, Professor Hopkinson has had in mind when developing his method of applying internal cooling.

South Metropolitan Report and Accounts.

The half-yearly report of the Directors of the South Metropolitan Gas Company, together with the main portions of the accounts, are published in other columns. They came to hand as final preparations were being made for the early printing of this week's "JOURNAL," in view of Bank Holiday. The interest contained in them, however, demands more than a cursory exami-

nation of their contents; and therefore comment and comparison are deferred till next week's issue. The merest glance, however, satisfies that the Company show good cause, under the circumstances of the half year, for being congratulated, and for mutual congratulation as between Board and proprietors. The financial result of the half-year's trading is that the Directors are able to pay from the profits the excellent dividend of £5 9s. 4d. per cent., and to increase the carry-forward by £1206. The report informs the proprietors that the sale of gas has increased by 1·59 per cent.; and the Chairman (Mr. Charles Carpenter, D.Sc.) will probably, at the meeting of the proprietors, translate this percentage figure into the substantial whole number of 105,516,000 cubic feet. The Company carbonized 14,611 tons of coal more than in the corresponding half of 1912, and spent on coals an additional £27,021. The working continues of high-class order; and the report makes reference to the improved purity of the gas supplied. It is interesting to read, in view of Mr. Carpenter's paper before the Société Technique du Gaz [*ante*, pp. 12, 30], a reference in the report to the process that has been developed at the Company's works for dealing with carbon bisulphide in coal gas by catalytic action. It is stated: "The working of the new sulphur-removal apparatus has been satisfactory. The erection of plant on the same principle, but more simple and less costly in construction, has been commenced at the East Greenwich works." This speaks of complete confidence in the process.

Refractory Material Temperature Tests.

To our columns this week, Dr. J. W. Mellor, who has been intimately associated with the work of the Refractory Materials Committee, makes a contribution on the subject of refractory material temperature tests. The article consists mainly of notes (previously published) which have a bearing on the subject of the use of Seger cones. The article is divided into considerations upon (1) the influence of time and temperature on the speed of the vitrification of clay, (2) influence of texture on the rates of vitrification, (3) slow vitrification compared with rapid vitrification, (4) the fusing test as a standard of refractoriness. We hope that Dr. Mellor's proposal to contribute a further article to our columns, incorporating his views on the remarkable transmutation of clay into iron which is taking place daily at certain gas-works—thus converting good clays into fusible ferruginous slags—will materialize in a short time. Our contributor is a busy man; but he is the capable master of a subject of which we of the gas industry want to know more.

Talk Exhibition.

During the present season of gas company meetings, it is hoped that chairmen will not omit to make an announcement regarding the National Gas Exhibition, to be held at Shepherd's Bush from Oct. 1 to Nov. 1. The matter published in last week's issue will give them plenty of points for such an allusion to the subject; and care should be taken to secure publication of what is said in the local Press. Gas shareholders ought to be good local advertisers; and therefore to get them to the exhibition will be a good stroke, and worth working for. Sir Corbet Woodall spoke of the exhibition at the meeting of the Gaslight and Coke Company. But we must regard Mr. R. J. Neville Neville, M.P., the new Chairman of the Brentford Gas Company, as a sinner on account of his omission to refer to the subject at the meeting of the proprietors on Friday, seeing that the exhibition buildings are in the area of the Company. It was of course an oversight; for the Chairman and Directors of the Company and their Engineer and Manager (Mr. Alex. A. Johnston) are giving the exhibition a large amount of enthusiastic help and support. However, Mr. Neville had so much else of interest to talk about concerning the immediate affairs of the Company's working and prospects that his oversight was pardonable.

The Title of the Exhibition.

In reference to our comment last week upon the extended title that has been bestowed upon the Exhibition—the National Gas Congress and Exhibition—and the expression of view that there ought to be a transposition of "Congress" and Exhibition, we learn that the extended title will not be used for public advertising purposes, as witness the photographic reproduction of the wall poster in last week's issue. We are glad of this, on the ground of attractiveness to the general public, who are better drawn by novelty and life in exhibitions than by those things that are termed "Congresses," and which—however far from the truth it may be, and however much to be deplored—always seem to suggest to the public mind a dry and wearisome atmosphere. The reason the title was extended was to secure interest in quarters where the plain appellation of "National Gas Exhibition" would not have had weight; and the change has been, and is likely to be further, rewarded by this interest. There is generally a reason for a change made by an Executive Committee such as the one in charge of this big scheme; but it happened that the particular reason on this occasion was not within our knowledge when writing the article that appeared last week. However, the title is subject to abbreviation and extension just as the object in view dictates; and to the public this special piece of enterprise on the part of the gas industry will continue to be known by the brief but effective name of "National Gas Exhibition." This being so, we and others are satisfied.

Oil and Coke.

In a spirited speech, full of point and interest, though somewhat long, Mr. R. J. Neville Neville, M.P., inaugurated his advent in the chair of the Brentford Gas Company last Friday. Mr. Neville's name has been associated with the Board of the Company for some twenty years, and for a long time with other gas concerns as a shareholder. His knowledge of gas affairs is not only administrative and commercial, but, as one learned in the law, he has frequently appeared in the interests of gas undertakings before Parliamentary Committees and in the Law Courts. Before Parliamentary Committees, appearance is, of course, now barred by his membership of the House. However, he had a good tale to tell the proprietors of the Brentford Company on Friday, and he told it well. The Company have been financially extremely successful during the half year, despite a penny reduction in the price of gas; and they have been working under specially favourable conditions. The Board some time since entered into long contracts for coal and oil, and at favourable prices; and during part of the half year they have been making gas from coal for which they were still paying the old prices, and oil for which they are only paying rather more than half the current prices. This contract runs to next August; and in this the Company have valuable relief. There is little hope, however, that, so far as human knowledge can penetrate the situation, the Company or any other gas undertakings are likely to get back again to some of the figures they have paid for oil in the past. The Company have been fortunate too with coke; but as the accounts of gas companies generally come in, we notice in certain areas the rotund character of the figures under the heading "coke in store." We also see that some carburetted water-gas plants have been altogether closed down during the half year, and several others partially so; and, with oil at 4d. to 5d. a gallon, this is not to be wondered at. After the holiday season is over, there should be a special local campaign by gas undertakings to develop the domestic use of coke. The London and Suburban Gas Companies have joined together to take up coke-stimulation work, and maintenance of values in reference to other solid fuels. Among the interesting figures produced by Mr. Neville was one showing that the Brentford Company have gas accounts with 90 per cent. of the householders in their supply area. They cannot hope to improve much upon this percentage; but the 90 per cent. offers a large field for gas-fires, hot-water circulators, gas-irons, and so forth. Increasing the service of the Company to those householders, and raising from the additional service the totals of the accounts of the latter, is the direction in which the energies of the Company are at present being largely exercised.

An Industrial Council Inquiry.

Somewhat more than a year ago, the Industrial Council were informed of the anxiety of the Government to have inquiry made into certain matters which appeared to them to be difficulties in the way of peaceful and friendly relations between employers and workmen; and the Council were asked to consider these points and report to the Government the conclusions at which they might arrive. The questions which it was desired specially to refer to the Council were: (1) What is the best method of securing the due fulfilment of industrial agreements? (2) How far, and in what manner, industrial agreements which are made between representative bodies of employers and of workmen should be

enforced throughout a particular trade or district. The inquiry has been held, and it is evident that much trouble has been taken in investigating the matters upon which information was sought. Close on forty meetings were held, at which evidence was given by almost a hundred witnesses, representing the employers and the workpeople in the majority of the principal industries of the country; and a circular-letter was addressed at the commencement of the proceedings to 2000 of the employers' and workers' bodies, inviting them to forward a statement containing any observations they might desire to offer regarding the matters to be dealt with. The report of the Council (the Chairman of which is Sir George Askwith, K.C.B., K.C.) is a comprehensive document; and there are appended to it some memoranda signed by individual members. Understanding that there is no legal definition of the term "industrial agreement," the task was first essayed of securing a working definition; and it was decided that such an agreement may be described as an arrangement arrived at by employers and workpeople with a view to formulating the general conditions of employment in a particular trade and district. The remark is, however, made that industrial agreements, considered as contracts between employers and employed, cannot fairly be compared with the ordinary commercial contracts made between individuals or corporate bodies, because such agreements—especially on behalf of the workpeople—are frequently made by representatives who, owing to the numbers involved and the circumstances surrounding trade movements, find it difficult to obtain proper authority or ascertain the wishes of the men.

Some Points from the Report.

Mention is made in the report of the fact that many industrial agreements contain no clause providing for cases of disagreement regarding the interpretation of the document; and the opinion is expressed that such a clause should form part of every agreement. A model clause of this character, it is considered, would be one which provided that, in the event of a dispute arising as to the interpretation of an agreement, the point in dispute should be referred to an independent chairman, or to arbitrators, or a court of arbitration, agreed upon in each case by the parties. If the parties failed so to agree, the matter should be referred to a chairman or a court of arbitration appointed in accordance with the provisions of the Conciliation Act, 1896. The Council express the opinion that the extent to which some form of conciliatory machinery exists in connection with the various industries of this country is a marked feature of the industrial life of the community, and that the success which has attended the operations of the various voluntary boards of conciliation and arbitration points to the desirability of the continued maintenance of this form of adjusting trade disputes. They think it would be inexpedient to attempt to substitute for these voluntary forms of machinery some alternative method based upon principles other than that of mutual consent. Monetary penalties for the breach of agreements are not advocated; but the view is taken that moral influence should in every feasible way be brought to bear in favour of the strict carrying out of agreements.

Views of the Council.

While compulsory arbitration is not at all favoured, it is regarded as of great importance that the conciliation board or joint committee should possess means of arriving at finality. That is to say, before a strike or lock-out is resorted to, there should be a pronouncement on the question at issue by some independent body, or impartial individual. In other words, where the interpretation or an alleged breach is in dispute, there should be no stoppage of work pending the reference of the difference to some impartial tribunal. As to the second portion of their reference, the Council have come to the conclusion that, subject to an inquiry, made by an authority appointed by the Board of Trade, an agreement entered into between associations of employers and of workmen representing a substantial body of those in the trade or district should, on the application of the parties to the agreement, be made applicable to the whole of the trade or district concerned, provided that the agreement fulfils the requirements laid down in a draft scheme included in the report, as well as conditions to secure that certain notice should be given of intended changes in wages or hours, and that there should be no stoppage or alteration of the conditions of employment until the dispute had been investigated by an agreed tribunal, and pronounced upon.

One Per Cent.

The suggestion, of which much has been heard in recent times, that the profits of municipal undertakings applied in relief of the rates should not exceed 1 per cent. per annum on the outstanding capital of the concern, came before the recent annual conference of the Urban District Councils' Association. A paper was read, and with it a motion was associated, to the effect that in the opinion of the conference the percentage of profits so allocated should not exceed the amount named; the author—Mr. W. T. Postlethwaite, the Clerk to the Swinton and Pendlebury Urban District Council—remarking that the 1 per cent. had suggested itself to him by the decision of Lord Donoughmore's Committee on a Bill in which his Council were concerned. Reference was made by him to the doubtful policy of indirect taxation in general, as well as to the fact that municipal trading was never intended to be a means of relieving rates. He said it was never intended that local authorities should obtain the power to carry on these concerns "in order that they might (should he say?) hoodwink the ratepayers as to the amount of rates they were collecting and spending." He thought, and many others think with him, that the time has arrived when this question should be faced. The common-sense view enunciated by Mr. Postlethwaite was to the effect that, when a local authority are endowed with powers to carry on an undertaking—be it gas, water, or tramways—they should do so for the benefit of the community, and not to relieve the rates. The conference seemed to be of opinion, however, that the matter was far too large to be disposed of out of hand, and a suggestion was put forward that the paper should be placed first on the *agenda* for the next conference, in order that the subject might be threshed out in all its bearings. The author thereupon asked to be allowed to withdraw his motion, and to submit another paper, possibly in some slightly different form, at the next gathering. This idea was agreed to; and so, for a time at all events, the Association are saved from the necessity of expressing an opinion on this important question. If when it is re-introduced Mr. Postlethwaite's motion should be rejected, there will, one would imagine, have to be some stronger argument used against it than that urged by a member during the brief discussion which has already taken place. This argument was to the effect that, by passing the motion, they would be "putting a very strong weapon in the hands of a party—already too strong in this country—which was working against the success of municipal trading." In connection with this contention, it might be asked what exactly is the interpretation intended to be placed upon the word "success."

PERSONAL.

The Directors of the Seville Water-Works Company, Limited, have increased the salary of the Secretary, Mr. J. M. Hamilton, by £125 per annum. Mr. Hamilton has occupied the position for twenty years.

In consequence of ill-health, Mr. A. Absolon, an assistant in the first class in the chemical and gas-testing department of the London County Council, has been retired as from Sept. 30 next. He has been twenty-eight years in the service of the Council and their predecessors, and has been granted a retiring allowance of £115 9s. 4d., as from and including the 1st of October.

It will be seen from our "Miscellaneous News" that the London County Council, at their meeting last Tuesday, sanctioned a scheme for the rearrangement of the work of the chemical and gas-testing department consequent upon the retirement of Dr. Frank Clowes. As from the 1st of October, Mr. J. H. Coste, now Chief Assistant in the department (a position he has held for some years), will have the title of Chemist, and be transferred to the Public Health Department. The gas-testing work will, in future, be carried out under the direction of the chief officer of the Public Control Department.

In the "Journal" last week, it was announced that Mr. C. Valon Bennett, Assistant to Mr. F. W. Rapkin, the Engineer and Manager of the Dartford Gas Company, had been appointed to the position of Engineer and Manager to the Rochester, Chatham, and Gillingham Gas Company. For the vacancy in the assistant engineership at Dartford, Mr. Bernard P. Bezant has been selected. Mr. Bezant (who is the son of a member of the editorial staff of the "Journal") was educated at the Whitgift Grammar School, Croydon. Subsequently, for upwards of two years, he was a day student in the engineering shops and chemical laboratory at the Battersea Polytechnic. Following this he was articled for three years to Mr. S. Y. Shoubridge, the Engineer and Manager of the South Suburban Gas Company; and since the completion of his pupilage, he has been junior assistant to the Company.

ELECTRICITY SUPPLY MEMORANDA.

WHERE there are contracts for public lighting based on the supply of illumination, with penalties for deficiencies, the system, with gas lighting, works very well. It is a form of contract that will spread, and with vigour, if the Street Lighting Specification Committee come to a definite conclusion as to a model specification that will find general acceptance among lighting authorities. In connection with the drafting of a specification, the electrical interests have been well forward in the matter of representation; but there has not been much heard as to what the rank-and-file think about it who will have to shoulder the obligations. The Metropolitan Electric Supply Company seem to feel a little bit nervous about entering into a contract with penalties attached for any back-sliding from a prescribed minimum luminosity. There have been negotiations between the Company and the Highways Committee of the Acton District Council for main street lighting. A provisional agreement was arranged between their representatives for an installation of 450-candle power lamps, with minimum luminosity and deficiency penalties specified. When, however, the Company came to seriously look into the matter, they desired the amendment of the specification by altering the nominal illuminating power of the lamps to 400, and they would only agree to penalty clauses for diminished luminosity in consideration of increased payment per lamp. In other words, the Company were proposing to protect themselves against penalties by making the Council prepay the money that the Company apparently anticipated would be required for the purpose. That is what their proposal amounts to. However, the Committee have informed the Company that they are not prepared to depart from the provisional stipulations, and that 450-candle power lamps must be installed with a minimum luminosity of 90 per cent.—that is to say, the so-called 450-candle power lamps must never fall below 405 candles. That in all conscience is a sufficient margin of safety, seeing that the electricians claim that there is no appreciable variation in the candle-power of their metallic filament lamps. The trouble, of course, is that the electricity industry do not call a spade a spade; and it is an uncommonly fine discovery it metallic filament lamps give the manufacturers' rated candle power under the stated voltage and wattage. The Committee, too, are insisting on a clause providing for a penalty should the luminosity, on a specified test, be found to depart from the minimum in the downward direction. The Committee do not express any appreciation of the acuity of the Company in proposing that the Council should pay an extra price in order to provide the Company with funds with which to pay the penalties.

Luminosity and Penalties.

A sudden quietness overcame our electrical contemporaries when they found they had been writing, in tall language and somewhat foolishly, upon the coming of a ½ watt-hour candle lamp when the only promise is that, if ½-watt lamps come at all, they will only be for large candle powers. Mr. E. T. Ruthven Murray has, however, written to "Electrical Industries" on the general subjects of revenue reducing lamps and tariffs, and as to the prospect of filling up the gaps in revenue made by the former. He offers some introductory remarks which are a bit ambiguous. He regards it as fortunate that the small ½ watt per candle lamp is a long way off. Fortunate, too, is it that "the drawn-wire lamp is rapidly replacing the lamp with the squirted filament, which was considerably more efficient." That is not what electricians usually say; but there are, of course, a few truthful ones to be found in the electricity industry. Again, Mr. Ruthven Murray declares that "the newer lamp is less fragile, and its life is shorter." That, as written, appears to be a contradiction; but Mr. Murray's authority may be accepted. Touching the means at hand with which to derive compensation for revenue-reducing lamps, he thinks that the rateable value systems as favoured by most of the Point-Fives is too limited in its application to meet the needs of the case, or to be more than a mere stop-gap pending the introduction of a universally applicable basis for maintaining the lighting revenue. There is an admission that the unnecessary reduction of charges in the past has added to the difficulties and complications of the situation. But (here is the sting of his letter) "the greatest error has been, and is, the booming of low rates—ridiculously low rates—for heating and cooking supplies." Mr. Murray is a philosopher. The rates quoted for these uses—frequently lower than are charged for traction and power supplies in the same districts—have convinced the lighting consumers that the higher lighting rates are monstrously unfair and exorbitant. It is not the view of Mr. Murray that the rate at which cooking and heating will develop will help the electricity industry much. He points to what is a fact, that the gas companies built up a big cooking and heating business, when they "succumbed" (which is not a fact) to the competition of electricity for lighting, by continuing their lighting rates for the new services. Concerning the "succumbing," when an electrician shows an uncommonly large amount of good sense, he generally manages to leave a blot upon it somewhere. The difference between the two industries is that the gas industry at lighting rates gives heating and cooking consumers heat value for money; the electricity industry cannot do so even at rates diminished to a very fine point.

Rates and High Efficiency Lamps.

Fortified about by rules and regulations, electricity supply is still responsible for a considerable sacrifice of human life. On March 5 last a youth was killed by electricity at the Langwith Colliery of the Sheepbridge Coal and Iron Company. Affixed to a prop was an electric lamp; and after the boy fell, it was found that the lamp was hanging down. As a result of an official inspection by the Government Department concerned, the manager was summoned for breaches of the electrical rules: (1) For having the metallic covering of a lampholder unearthed; (2) for not protecting live parts—switch and fuse; and (3) for not having a metallic switch-box earthed. The only defence that could be offered was that the manager had taken every reasonable means of avoiding disaster by the appointment of qualified electricians to prevent contravention of the official rules. A fine of £1 was inflicted, and £5 5s. costs.

Rules and their Neglect.

If the lamp referred to in the previous paragraph had been earthed, the chances are that the victim of the neglect would have been alive to-day. We see from a paragraph in the "Electrical Times" that in all Ferranti heating and cooking apparatus, provision is made for earthing metal parts which are not intended to carry current. The heating units have a central pin for this purpose, and an additional conductor is provided in the flexible cord to permit of earthing at the wall socket or switch panel. Messrs. Ferranti rightly emphasize the importance of earthing, and advise that no apparatus should be installed which has not been earthed satisfactorily to the conduit system, if this is electrically continuous, or to the nearest water-pipe. The use of the word "rightly" shows that the "Electrical Times" is in agreement with Messrs. Ferranti.

Importance of Earthing.

Noted as a tendency on a previous occasion, the makers of electric cooking apparatus continue to turn their attention to the production of smaller type ovens—doubtless thinking that the small oven, with limited space to be heated, will attract in the first place, as being cheaper, and, in the second place, as being a means for securing a lower energy account. The trouble found here is that the smaller the oven, naturally the greater the restriction of service; it gives no latitude to the householder. He must always have small dinners, and never on any account attempt to entertain his friends to a hot meal. The electrical industry, however, finding difficulties in the introduction of ordinary cooking outfits, are welcoming these smaller ovens, on the principle that "half a loaf is better than no bread," or that getting in the thin end of the wedge often means something greater. Perhaps it will not be so in this case. It is probable that the householder will soon become somewhat awearied of the restrictions and foibles of his liliputian cooker, and of obeying the new commandments of the electric cookery teachers [*ante*, p. 293], and so will never consent to transfer himself from the small electric outfit to the larger and more expensive one, but will gladly revert to gas cooking—the same as some have already done who were led astray by the smooth tongue of the electrical canvasser. The "Electrical Times" refers to the scope for small ovens, and points out that, in some households, a joint is only cooked once or twice a week, and that at other times ovens are only used for warming-up things. It overlooks the substantial character of the Sunday dinner, when the whole of the members of the family are assembled. Our friends of the paper mentioned think that an electric-oven ought to be made to fit a joint, the same as a boot should fit a trim foot. If a joint is bottled or boxed up in this way, it is said that there is less chance of the joint shrinking, and there is less heating work to be done by the current; so that there is a double economy. The convenience of the user is of secondary importance—not only in respect of the oven, but on the top-plate. The "Electrical Times" does not think that the small householder requires everything provided on a gas-cooker. A greater mistake was never made. It is the range of convenience provided by a gas-cooker that has carried it to such an abundant popularity, and this convenience is not going to be abandoned in the cause of the electrical industry. Our friends think that "the needs of the small householder would be met by a small self-contained oven, perhaps a couple of boiling-rings, and a small grill." The capacity of an oven for work must not be measured by a man's house so much as by the capacity of the man and his family. A large householder who cooks a joint each day may not require a larger oven than a man who cooks two joints a week; the latter may, in fact, have more mouths to feed. The chances are the two-joint householder will normally have larger joints than the joint-a-day householder. We do not think that the inconveniences of the type of oven the "Electrical Times" advocates will be tolerated.

The Small Householder.

Many a time we have protested against the flagrant unfairness that abounds towards private gas enterprise, through the members of municipal electricity supply committees being on the governing bodies of other local public institutions, and so pulling the wires in favour of electricity supply,

Wheels Within Wheels.

to the disadvantage and the ultimate eviction of gas from those establishments. This use of position to obtain preferential treatment for the electricity department is unjust, and is certainly inimical to the interests of the ratepayers. Hastings is a notorious sinner in this respect. We have pointed to some instances of subterranean workings there through the several nooks in local government filled by members of the Electricity Committee, and which positions they use for the advantage of the Corporation Electricity Department and the disadvantage of the ratepayers. At a recent meeting of the Education Committee, there was a recommendation brought forward that the lighting of certain schools should be changed from gas to electricity. Several schools are affected; and for them the total account for gas last year was £44 15s. 3d., including lighting, a gas-cooker, a gas-ring, five iron-heating appliances, and a drying apparatus. The account is not a heavy one in view of what it all includes. To displace this economical condition of things, the Education Committee are proposing to spend £174 15s. on fitting up the schools for lighting alone; while a special length of 343 yards of electric cable will have to be laid at an estimated cost of £120, and other expenditure incurred by the Electricity Department in order to secure these small customers for lighting purposes. That is to say, about £300 has to be expended to secure part of the revenue named. A singular thing is that the Committee have agreed to make this substitution of electricity for gas, notwithstanding that the Electrical Engineer, with a fine disregard of other ways of dealing with the matter, says that it is a difficult thing to give the annual cost of electric lighting, as this depends upon the weather and hours of burning. Of course, it does; but is Mr. Russell Ferguson so deficient of calculating capacity that he could not have given the Committee the cost of electric lighting for a given number of hours of a named number of lamps of described candle powers, so that comparison could be made with modern forms of gas lighting? The Education Committee do not, on the face of the published report, appear to have investigated this matter; and also on the face of the report they do not appear to want to trouble themselves over it. In our opinion, they have (if the reports correctly illustrate the amount of investigation they have made), shown a dereliction of duty in the matter. There was a proposal, at the meeting of the Education Committee, that the report should be referred back for further consideration; but this was lost by five votes to twelve. Among the five in favour of the reference back was only one member of the Electricity Committee—Mr. Morgan. Of those who voted among the twelve who are members of the Electricity Committee were the Chairman of the Education Committee (Alderman R. W. Mitchell), the Vice-Chairman (Mr. J. Stace), and Mr. Clement Hill, who is Chairman of the Electricity Committee. Alderman W. Coussens also voted; and we believe he was a member of the Electricity Committee in 1912. Mr. J. N. Collins also voted; but at this distance from Hastings we are not aware as to whether or not he is related to Mr. H. N. Collins, a member of the Electricity Committee. Anyway, there are a sufficiency of certainties to see that fair play cannot be secured for the lighting business of public establishments while this condition of things exists in local government. The spectacle of members of the Hastings governing bodies being led by the noses by members of the Electricity Committee is not edifying.

A Cable Extension.

When the matter of extending the electricity main to one of the schools was before the Borough Council, it was strongly supported by members of the Electricity Committee, though at the time the Education Committee had not determined to carry out the work. The members of the Electricity Committee who are also members of the Education Committee, however, undoubtedly had a pretty good inkling that a majority of their fellow-members of the Education Committee would display a humiliating obedience to their wishes. The motion for the adoption of the recommendation as to the cable extension was moved in the Council by the Deputy-Mayor (Mr. Clement Hill) who, as stated above, is Chairman of the Electricity Committee and a member of the Education Committee; and Alderman Mitchell, the Chairman of the Education Committee, and a member of the Electricity Committee, supported the proposal. It would be all very funny if it were not all so unfair. But it is positively sickening, and a disgrace, that there should be this wheel-within-wheel business in local government, and that, in consequence of it, there should be this stunted consideration (if it is not a misuse of the term "consideration" to apply it to such doings) of such matters of local importance as the lighting of streets and public establishments. When this scheme for the extension of a cable for one school at a cost of £120 was before the Council, the Electrical Engineer babbled, as usual, as to there being six street lamps on the line of the main which could be fitted for lighting by electricity, and produce a "profit" on each of 30s. The 30s. profit in our judgment is a pure fiction, and does not merit respect or confidence. We cannot trace its existence in the "profits" of the department. Any ratepayer can test the matter for himself by multiplying the number of metallic filament street lamps, by 30s., and compare the result with the "profit" of the Department for the year [see last week's "Memoranda"]. We challenge the Electrical Engineer to disclose the whole of the at present hidden details on which he bases this so-called profit; and we shall be happy to discuss the matter with him. There is no expectation on our part that he will respond. But nevertheless we hope that he will; and if he can prove his case, we will acknowledge it in a very handsome manner. How men in the possession of their right senses can be talked into thinking that it is cheaper to generate units of electricity for metallic street lamps than for private lighting and public arc lighting passes our comprehension. However, we give Mr. Ferguson an opportunity of proving the validity of the 30s. "profit" per lamp.

Health and Eyesight.

In the same discussion, Alderman Mitchell stated (according to the published report) that "electric light was healthier for the children and cheaper." There are some men whose schooling was completed much too early, and who now want their education revised. For example, on the subject of ventilation, air movement, the noxious effect of stagnant air, the relative intrinsic brilliancy of lights, and other matters of current and urgent importance, modern knowledge would alter considerably their present narrow views and misconceptions. We should like to ask Alderman Mitchell to explain why he thinks the existence of electric light fittings in schools is healthier for the children; and we should also be pleased to hear from him how it is that light for light and hour for hour he fancies electricity is cheaper. Perhaps, too, the Alderman has not heard of the Illuminating Engineering Society, and of the recent report made by a Committee appointed by that body to consider the lighting of schools [see *ante*, p. 174]. The Committee uttered a very serious warning on the subject of the avoidance of glare in schoolrooms. Probably Alderman Mitchell's education on physiological matters does not extend so far as to enable him to know that there is not an indoor lamp existing that has such a bad effect on the eyesight as the metallic filament electric lamp, on account of the intrinsic brilliancy of the source of light being many times in excess of that of any other form of indoor lamp or burner. Is Alderman Mitchell prepared to challenge this assertion? If so, we will produce chapter and verse that will lead to his rapid conviction of want of knowledge on these subjects. We are right in this matter; we regard it, apart from the competition of the gas and electricity industries, as a very serious question; and we should be pleased to hear from the Alderman that he and his colleagues have taken steps to shield the eyes of the scholars attending these schools from the vicious effects of the metallic filament lamps. If they have not done so—it will, of course, mean extra cost in installation—then they are incurring a grave responsibility that men in public places, and dealing with public buildings where children and people assemble, ought to do their utmost to avoid. In the interests of municipal electricity supply, there is much that is disguised that the public and their "representatives" ought to know. The "Electrician," as recently as July 25, in an article referring to school lighting, says: "There is no doubt that one of the most important points in illumination of this kind is the avoidance of glare. Doubtless in many cases metal filament lamps with clear bulbs are used; and if such lamps are in the field of view when the scholars are looking at the blackboard [or anything else] the result can only be harmful." These are the words of a representative paper of the electrical industry.

Resignation of Mr. John Chew.

The oldest municipal gas manager in the country—Mr. John Chew, of Blackpool—has resigned his position owing to failing health. He is in his eighty-seventh year, and has been in charge of the gas-works since 1862; and in the "JOURNAL" for the 6th of May last we gave some figures from his jubilee report. We understand that he will be retained by the Corporation as their Consulting Engineer.

Next Year's City and Guilds Examinations.

We have received from the Superintendent of the Department of Technology of the City and Guilds of London Institute (Sir Philip Magnus, M.P.) the programme for the session 1913-14. It contains full information in regard to the examinations, including, as usual, a list of the works of reference which candidates are advised to consult while prosecuting their studies. As before, separate examinations will be held in "Gas Engineering," which will include manufacture, and "Gas Supply," including distribution and the various applications of gas. The Examiner in the former subject is Mr. Thomas Glover, of Norwich, and the examination will be held on Saturday, April 25, 1914. Mr. Walter Hole, of Leeds, is Examiner in "Gas Supply;" and candidates will be examined in this subject on May 2. Both dates are a week later than this year. In addition to the above-named subjects, examinations will, as hitherto, be held in "Coal-Tar Distillation and Products," "Coal-Tar Colouring Matters," "Heating and Ventilation," and "Structural Engineering." Elsewhere in the "JOURNAL" will be found the names of the prize winners in the last examinations. The programme contains an indication of the nature of the subjects on which questions will be set for the examinations next year, lists of scholarships, exhibitions, and money prizes offered by the City Livery Companies and other bodies (including special prizes of £3 3s. and £2 2s. by the Society of British Gas Industries), the money prizes given by the Institute, and the persons registered as qualified teachers. It may be obtained from any bookseller, or from the publisher, Mr. John Murray, Albemarle Street, W., price 9d. net (postage extra).

CITY AND GUILDS EXAMINATIONS.

The Prize Winners at the Last Examinations.

In the "Journal" for the 8th ult. (p. 106), the list was given of the candidates who passed the last examinations in "Gas Engineering" and "Gas Supply" in the Department of Technology at the City and Guilds of London Institute. We have now received from the Superintendent of the Department (Sir Philip Magnus, M.P.) a list of the prize winners in the subjects named, as well as in those of "Coal-Tar Distillation and Products" and "Heating and Ventilating Engineering." The following are their names, and the centres at which they studied.

Gas Engineering.

Final.—First prize (£3 and a silver medal), Harold Charles Edward Gripton, Regent Street Polytechnic.

Grade I.—First prize (£2 and a bronze medal), Herbert Greenwood, Halifax Municipal Technical College; second prize (£1 10s. and a bronze medal), Tom Rudge, Birmingham Municipal Technical School; third prize (a bronze medal), Leonard George Humphrys, Derby Technical College.

Gas Supply.

Final.—First prize (£3 and a silver medal), Frederick George Marsh, London County Council School.

Grade I.—First prize (£2 and a bronze medal), James Waite Gibson, Stockport Technical School; second prize (£1 10s. and a bronze medal), Tom Rudge, Birmingham Municipal Technical School; third prize (a bronze medal), Thomas Maitland Snowdon, London County Council School.

Coal-Tar Distillation.

Grade I.—First prize (£1 10s. and a bronze medal), Cyril Cuthbert Strickland, East Ham Technical College; second prize (£1 and a bronze medal), Moreton Ellerton Nicklin, Middlesbrough High School; third prize (a bronze medal), Cyril Mertie Warren, East Ham Technical College.

Coal-Tar Colouring Matters.

Grade I.—First prize (£1 10s. and a bronze medal), Isaac Shulman, Leeds University; second prize (£1 and a bronze medal), Pavitra Kumar Dutt, Leeds University.

Heating and Ventilating Engineering.

Grade II.—First prize (£2 and a bronze medal), Ambrose William Coffin, London County Council School; second prize (£1 10s. and a bronze medal), Joseph Ernest Evan Baskerville, London County Council School.

The money prizes in "Gas Engineering" and "Gas Supply" are given by the Goldsmiths' Company; those in "Coal-Tar Distillation and Products," by the Salters' Company; and those in "Heating and Ventilation," by the Institution of Heating and Ventilating Engineers. The medals are given by the Institute.

SOUTH METROPOLITAN GAS COMPANY.

The Directors' Report and the Accounts.

The following is the report of the Directors of this Company for the six months ended the 30th of June, which, with the accounts (an abstract of which appears below), will be presented to the proprietors at the half-yearly meeting to-morrow week.

The profit resulting from the past half-year's working has been sufficient to pay sliding-scale dividend at the rate of £5 9s. 4d. per cent. per annum, and to increase the amount carried forward by £1206.

Contracts for coal have been entered into at a still higher figure than that ruling subsequently to the national coal strike of 1912. This increase cannot be attributed either to legislative requirements or to the wages paid to miners, but to the great demand for export coal, which has enhanced the cost to the British user.

Residuals have fetched fair prices, especially in the case of tar and tar products.

The increased sales of gas amount to 1·59 per cent. above the corresponding period last year, the circumstances of which were particularly favourable to gas consumption.

Manufacturing costs have been reduced, and carbonization and purification charges are also lower; while the production of gas per ton of coal has been maintained and the purity improved. The working of the new sulphur-removal apparatus has been satisfactory. The erection of plant on the same principle, but more simple and less costly in construction, has been commenced at the East Greenwich works.

High-pressure lighting has maintained its popularity, and is extending in busy neighbourhoods. The number of public gas-lamps steadily progresses.

Time continues to strengthen the bond of co-partnership between the Company and its employees.

Charles Carpenter, Chairman.

July 30, 1913.

The Accounts.

The following are the principal portions of the accounts accompanying the preceding report.

The first two statements relate, as usual, to the stock and loan capital. The former sets forth that the standard rate of 4 per cent. is payable on £6,011,224 and £418,671 (Act of 1901) of stock; while the latter shows that the loan capital, the rate of interest on which is 3 per cent., amounts to £1,798,994 and £96,451 (Act of 1901). The third statement is the capital account. It stands as follows: Amount received, £5,328,820; nominal amount added by conversion (less premium), £2,996,520—total, £8,325,340. The items of expenditure are as follows:—

Capital account to Dec. 31, 1912		£5,087,373 17 9
Expenditure during half year to June 30, 1913, viz.—		
New and additional mains and services	£1,170 4 9	
New and additional meters	1,120 8 7	
New and additional stoves	1,203 12 9	
		3,494 6 1
Total expenditure		£5,090,873 3 10
Balance		237,946 16 2
		£5,328,820 0 0
Nominal amount added by conversion, less premium		2,996,520 0 0
Total		£8,325,340 0 0

The net revenue account shows a sum of £299,262 3s. 3d. applicable to dividend on the ordinary stock. Following this are the statements relating to the reserve, renewal, and insurance funds. They show that the balances on June 30 were as follows: Reserve fund, £191,755; renewal fund, £35,606; insurance fund, £21,451.

The following is the revenue account:—

Expenditure.

Manufacture of gas—		
Coal into store, including £3719 2s. 3d. for London Port and tonnage dues	£443,726 4 0	
Purification	22,033 16 3	
Salaries of Engineer and Officers at works	18,397 2 8	
Wages (carbonizing)	48,646 2 5	
Repairs and maintenance of works and plant, less £3988 8s. 0d. received for old materials	108,492 17 0	
		£641,296 2 4
Co-partnership for twelve months to June 30, 1913	48,348 3 11	
Less on account	16,000 0 0	
		32,348 3 11
Distribution of gas—		
Repair, maintenance, and renewal of mains and service-pipes	£43,570 11 10	
Salaries and wages of officers, including rental clerks	21,662 0 4	
Repair and renewal of meters	27,344 8 11	
Repair and renewal of stoves	41,076 14 7	
Repair and renewal of gas-fittings	41,585 1 8	
		178,238 17 4
Public lamps, labour and materials £14,953 7s., less £14,451 9s. 11d. received for the same		501 17 1
Rents, rates, and taxes—		
Rents payable	£1,397 11 1	
Rates and taxes	58,119 13 8	
		59,517 4 9
Management—		
Directors' allowance	£2,803 2 8	
Salaries of Secretary, Accountant, and clerks	4,761 0 3	
Collectors { Ordinary	6,032 3 6	
Collectors { Slot meter	10,540 11 1	
Stationery and printing	4,137 5 2	
General charges	10,176 10 3	
Company's Auditors	112 10 0	
		38,563 2 11
Miscellaneous—		
Law charges		665 9 7
Parliamentary charges		1,002 10 7
Bad debts		1,742 5 7
Stolen from 2189 slot meters broken open		286 17 6
Sick, accident, and superannuation funds		15,086 7 6
National Insurance Act charges		3,604 4 4
Gas Referees and Official Auditor		239 6 9
Leasehold Renewal Fund		300 0 0
Total expenditure		£973,392 10 2
Balance carried to net revenue account		209,121 15 4
		£1,182,514 5 6

Receipts.

Sale of gas—		
Lady Day, at 2s. 2d. per 1000 feet	£400,208 0 9	
Midsummer, at 2s. 2d. per 1000 feet	298,963 5 10	
	£699,176 6 7	
Public lighting	17,290 12 10	
		£716,466 19 5
Company's meters at rent: Ordinary, 95,325; slot, 266,800	£41,461 19 3	
Company's stoves at rent: Ordinary, 82,086; slot, 220,524; fires, 38,659	35,632 5 2	
Gas-fittings	48,870 10 10	
		125,964 15 3
Residual products—		
Coke, less labour and cartage	£205,709 13 8	
Breeze, ,, ,,	3,686 6 5	
Tar and tar products, less labour	56,911 9 2	
Sulphate of ammonia ,, ,,	72,260 16 9	
		338,568 6 0
Rents receivable		1,422 14 10
Transfer fees		91 10 0
Total receipts		£1,182,514 5 6

Total amount paid in salaries for half year, £45,192 9s. 1d.
,, ,, ,, wages ,, £296,823 3s. 9d.

The following tables relate to working :—

Statement of Gas Made, Sold, &c.

Quantity Made.	Quantity Sold.		Total Quantity Accounted for.	Number of Public Lamps.
	Public Lights (estimated).	Private Lights (per Meter).		
Thousands.	Thousands.	Thousands.	Thousands.	
6,997,352	179,207	6,550,154	6,823,442	24,634

Statement of Coal.

In Store Dec. 31, 1912.	Received During Half Year.	Carbonized During Half Year.	Used During Half Year.	In Store June 30, 1913.
Tons.	Tons.	Tons.	Tons.	Tons.
67,946	614,862	568,226	1008	113,574

Statement of Residual Products.

Description.	In Store Dec. 31, 1912.	Made During Half Year.	Used During Half Year.	Sold During Half Year.	In Store June 30, 1913.
Coke—cwt.	193,460	7,013,740	1,750,940	5,038,740	417,520
Breeze—yards	11,286	111,334	55,403	54,308	12,909
Tar—gallons.	409,752	5,435,803	5,440,785	24,162	380,608
Ammoniacal liquor—butts	8,901	212,762	214,594	..	7,069

The remaining statement is the balance-sheet, which gives the value of the stores in hand at the close of the half year as follows: Coal, £83,735; coke and breeze, £16,431; tar, ammonia, and products, £98,440; and sundry plant and stores, £343,584. The figures this time last year were: Coal, £82,200; coke and breeze, £12,429; tar, ammonia, and products, £56,681; and sundry plant and stores, £312,490.

A sum of £48,361, co-partnership bonuses and savings, has been deposited with the Company; and the total of the superannuation and guarantee funds is £66,807. The figures last year were £32,084 and £69,351.

PURIFICATION OF COAL GAS.

We have received a copy of a dissertation for the degree of Doctor of Engineering, presented to and accepted by the Royal Technical College at Hanover, by Mr. George Anderson, son of Mr. William Anderson, the Engineer of the Hanover Works of the Imperial Continental Gas Association. It is in two parts, the first of which deals with the purification of gas from sulphuretted hydrogen, and the second with the purification of gas from organic sulphur compounds.

A review is given of the methods used for the removal of sulphuretted hydrogen from gas from 1806 onwards. The theory of oxide purification is briefly referred to, and then experiments made by Mr. Anderson on three descriptions of ferric oxide are described. His first series of experiments were made with dry sulphuretted hydrogen practically free from air. From them he concludes that the duty of purifying material is not proportional to the amount of iron present in it, and that it increases with the fineness of the material, but diminishes with the rate of flow of the gas. Also, that the degree of hydration is virtually without influence on the efficiency, and that oxide which has been practically saturated with sulphuretted hydrogen will take up very little more sulphur. Ammoniacal sulphuretted hydrogen gives the same results as pure sulphuretted hydrogen, and the composition of the products is the same in both cases. Of the total sulphur absorbed, 15 to 38 per cent. is extractable by carbon bisulphide, and on the average 4 per cent. of the total sulphur is present as disulphide of iron. On oxidation of the product by air at low temperatures, only traces of ferrous sulphate are found, and the greater part of the sulphur separates as free sulphur, though the disulphide of iron is not oxidized.

The experiments on which these conclusions are based were made with undiluted sulphuretted hydrogen. In the next series of experiments, Mr. Anderson used sulphuretted hydrogen diluted with coal gas to an extent corresponding approximately with the proportion of sulphuretted hydrogen in crude coal gas. The results of these experiments showed that the oxide was not fouled to the same extent by the diluted as by the concentrated sulphuretted hydrogen. The oxide was more thoroughly fouled when the rate of flow of the gas was lower; and the oxide acted better with moist than with dry gas. Possibly this was due to the moisture being favourable to revivification, which took place *in situ* to some extent, owing to the presence of 0·1 to 0·3 per cent. of oxygen in the gas. Mr. Anderson next records observations which he has made during three years' supervision of the purifying plant at the Hanover Gas-Works. The oxide used was an artificial preparation of a firm at Wesel—being a residue from the working-up of copper. Lux material was also used. The Wesel oxide was used in two degrees of granulation—one being very fine. This approached Lux material in activity, since one ton of it purified 5,960,000 cubic feet of gas; while a ton of Lux material purified about 6,280,000 cubic feet of gas. The larger grained oxide purified only 4,511,000 cubic feet of gas per ton. The Lux material and the fine oxide both reached a content of 68 to 69 per cent. of sulphur, whereas the coarser oxide contained only 58·9 per cent. of sulphur. All three materials were used without sawdust, and, as put into the purifiers, contained about 25 per cent. of moisture, The smaller duty of the coarser oxide was probably due in part to the oxygen in the gas not effecting such complete revivification of the larger granules. Mr. Anderson, therefore, concludes that a high degree of fineness of the material is of great importance in securing a high duty. This conclusion, however, only directly applies to new material, and not to material which has been revivified. Experiments were made on the absorption of oxygen in revivification *in situ*. The percentage of oxygen remaining in the gas, after it had passed through each purifying vessel was determined, and it was found that revivification gradually became more sluggish in each vessel in series. This proved to be due to the drying of the oxide by the heat of revivification; and the sluggishness of revivification was checked by introducing steam with the gas, in the proportion of 0·13 to 0·3 per cent. by volume. The addition of steam was controlled according to the temperature of the gas. The temperature, taken by a thermometer on the lid of each purifying vessel, was kept only a few degrees above that of the crude gas.

The second portion of Mr. Anderson's thesis relates to the removal of organic sulphur compounds from coal gas. After referring to the nature of these compounds and to the limits which have been imposed on gas-works in this country, Mr. Anderson reviews the methods which have been employed for the removal of carbon bisulphide. He then deals with methods for the quantitative determination of sulphur in gas, and states that he has been unable to get consistent results by the Referees' method. Probably the inconsistencies which he found may be explained by the dimensions of the apparatus which he used not being such as to secure adequate draught with proper condensation. Finally, Mr. Anderson investigated the action of carbon bisulphide on hydrated ferric oxide, heated in a water bath, with a view to finding a simplified method for the extraction of carbon bisulphide from gas. His investigations follow very much the same lines as those made by M. Guillet, as reported in a communication to the Société Technique du Gaz en France last year [see "Journal," Vol. CXVIII., p. 988]. Mr. Anderson concludes, from laboratory experiments, that it may be possible in suitable conditions on a practical scale to employ ferric hydrate for the removal of carbon bisulphide from coal gas. The ferric hydrate must be heated to about 212° Fahr. by suitable means. The process would not involve the prior removal of carbonic acid from the gas.

Mr. Anderson's thesis presents a very valuable study of the conditions of purification of gas, partly based on exhaustive researches into the literature of the subject, to which he gives a great number of useful references, and partly based on his own laboratory investigations. We venture to express a hope that he may translate his work into English, and so make it accessible to a wider circle of readers.

THE MODERN HUMPHREY HIGH-POWER LAMP.

In the development of the low-pressure high-power gas-lamp—generally known among our American gas friends as "Gas Arcs"—the name of Mr. A. H. Humphrey, of New York City, stands high, both as a pioneer and as an inventor of improving devices that have raised the standard of performance and general utility. The earlier forms of his lamps received considerable adoption in this country; but the more recent ones, which transcend previous types, are not so well known here as they should be, and are likely to be. At the present time, Mr. William A. Aldrich, of Grand Rapids, Mich., is in this country; and, among other things in which he is interesting himself, is the fulfilling of a commission to ascertain the prospects of exploiting the latest of Mr. Humphrey's productions in this country. The probability therefore is that before long we shall hear more than we have hitherto done of the newer forms of lamp bearing the name of the American inventor, and into which he has introduced considerable merit. We have had an opportunity of inspecting one of the several latest models; among the features of which are simplicity, interchangeability, strength, good efficiency (as attested by a London photometrist), and cheapness.

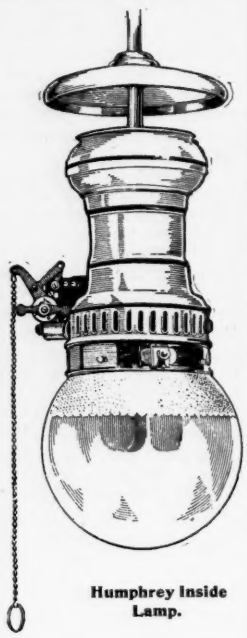
Some Details and Reasons.

The lamp inspected by us is one known as the No. 30 (three-burner) inside lamp. It has an excellent appearance, with its cream-coloured and gold-lined metal casing, or elegant brass finish; but external appearance has nothing to do with the quality of performance, and the ingenious provision made for maintaining efficiency and for readily keeping the lamp in a good state of repair. It has already been mentioned that the lamp is strongly constructed; there is a long life in this. All the parts that have any effect on efficiency and good working are interchangeable, so that renewals of them can be made *in situ*.

The best way to examine the lamp is to take one to pieces. First, the globe is held in position by screws on its swing support; but it is unnecessary to remove the globe for ordinary cleaning and mantle replacement, on account of the fittings connected to

the supporting ring. To open the lamp, one has to simply pull out a spring catch at the side. At the hinged part, there is also a catch, which holds the globe and its support clear away from the bottom of the lamp, and thus obviates accidents and relieves the strain that there would otherwise be on the hinge with the globe suspended in the support while the lamp was open. In the ordinary form of lamp, there is a plate (made of German silver) enclosing the burners, the principal purpose of which plate is to hold the mantles in position quite independent of the burners. This is an easy method of carrying and exchanging the mantles. But in England there is a preference for the universal mantle; and therefore, the burners are fitted with mantle-supporting nozzles, and the plate can be dispensed with. It is noticed that mantle chimneys are not favoured in these lamps; and this on the score that they are both a source of glassware and mantle destruction, and, under the climatic conditions of our large cities and towns, only increase the necessary labour in maintaining (by cleaning) the illuminating efficiency of the lamps.

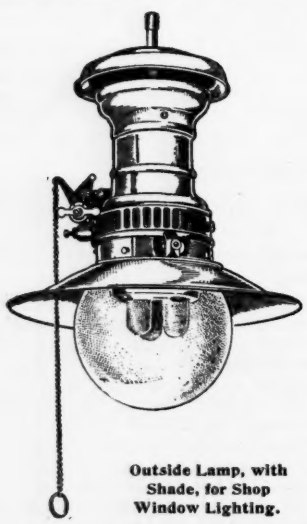
In the case of the outside lamp for general illumination, there is an outer glass shade, called by our American friends "a skirt." Over this there is a fine wire-gauze, so that, in the event of cold winds or rain causing fracture, the broken glass will not fall.



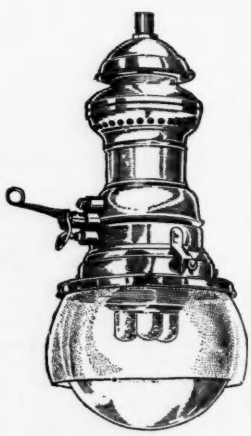
Humphrey Inside Lamp.

A Removable Single Screen, and the Air Supply.

Between the three burners, held in position by a small catch, and removable by thumb and finger, is a cylindrical screen placed vertically. This one screen takes the place of a screen for each burner; and, by it, the whole of the gas and air mixture supplied to the burners is, so to speak, filtered. This is particularly useful in the case of gas enriched by a high-candle power carburetted gas. It is impossible to stop up the meshes of the screen; as a matter of fact, the screen can be half filled with dirt without impairing the illuminating efficiency of the mantles—



Outside Lamp, with Shade, for Shop Window Lighting.



Outside Lamp for General Illumination.

the gas and air being conveyed to the burner nozzle in the same proportion whatever the condition of the screen. It is quite an easy matter to remove and clean the screen when attending to the lamp. The air by the way enters the apertures round the lamp-casing just above the globe—as seen in the illustration. It is very necessary that the secondary air to a lamp of this kind should reach the mantles uniformly, and this desirable condition the use of glass cylinders round the mantles assists in meeting. But owing to the construction of the new Humphrey lamp, the same uniformity of secondary air supply, it is claimed, is attained without the drawbacks (already referred to) attaching to the use of glass mantle cylinders. At the side of the lamp, there is a valve for the primary air to the single horizontal bunsen tube; and by pushing this out of engagement with the outer case, the latter can be removed, and the interior of the lamp be fully exposed. Among other things it is seen that two very substantially-constructed D-shaped chimneys are provided for the passing of the products of combustion to the top of the lamp,

An Important Valve.

In the illustrations will be noticed a valve, attached to which is a single operating chain for lighting and extinguishing. This is an important feature of the lamp. It is a gas-supply, pilot, and lighting and extinguishing arrangement all in one withdrawable piece. Only a bolt has to be removed to effect the withdrawal. The valve contains the gas-injector (also made of German silver), the nipple of which is interchangeable according to the calorific power, pressure, and density of the gas to be used. In addition there is a screw-regulation device, so that the lamp can be adjusted (from the outside, as in the case of the air) to a nicety. The operation of one chain does the dual work of lighting and extinguishing, through a small spring and arms which work the valve. With only a single chain in use, it is necessary, in view of any accidental extinguishing of the pilot light, to know whether the gas is "on" or "off." There is a small arm indicator for this purpose affixed to the operating device. When the indicator is in a horizontal position, the gas is "off;" and when in a vertical position, it is "on." One pilot jet serves the three burners; and means are provided for regulating a flashing-light. When the chain is pulled, a jet of gas shoots out about 1½ inches, and ignites the gas at the burner nozzles; when the chain is released, the gas goes back to the original dimensions of the pilot light.

Efficiency.

In America, using a 600 to 650 B.Th.U. gas, at 3 inches pressure, an efficiency of 35 candles per cubic foot is claimed for the three-burner lamp; while for a five-burner one a better case still is presented. The lamp has been tested in London, with gas of about 485 B.Th.U. net. The result was 32 candles per cubic foot. This is not an extravagant claim based on a visual estimate, but the attested result of testing by a well-known photometrist. The lamp was burning 13¼ cubic feet per hour; so that the total illuminating power was 426 candles from the three mantles.

Semi-Indirect Fittings.

Mr. Humphrey has also been devoting himself to semi-indirect gas-lighting fittings. Both he and Mr. Aldrich are convinced by experience in America that, notwithstanding the conservatism of some gas engineers in the matter of lighting fittings, the public favour for semi-indirect lighting will grow. People are nowadays more inclined than ever to pay for novelty; and here there is not only novelty, but excellent illumination. Some very beautiful designs of semi-indirect fittings have emanated from Mr. Humphrey. The one illustrated has been selected for the lighting of

Semi-Indirect Fitting with the Humphrey Lamp.

the handsome new offices of the Laclede, St. Louis (Mo.), Gas Company. A large ceiling-plate is provided; and above the hidden Humphrey lamp, there is a reflecting-plate If the lamp is enclosed in an inverted ornamental opal shade. Through this the light is partially distributed, and the remainder is reflected from plate and ceiling. "Sunlight at night," are the words of Mr. Aldrich, who, by the way, is remaining in England several weeks more, investigating the lighting conditions in this country.

Large Steel Pipe-Fittings.—According to a paragraph in the Engineering Supplement to "The Times," two types of special steel-plate pipe-fittings were recently installed as a part of the 60-inch riveted steel pipe-line for the North Side reservoir at Pittsburgh (Pa.). The fittings consist of five Y-pieces 60 inches diameter and one T-piece with two 60-inch outlets and one 48 inches diameter. It was originally intended to make these fittings of cast iron with a thickness of 1½ inches. But the contractor proposed to make them of steel plates; and, after careful consideration, the city authorities accepted the substitution, with a corresponding reduction in the cost of the work. The use of the steel-plate instead of the ordinary cast-iron construction resulted in a considerable saving in weight. The shipping weight of the Y-fittings was approximately 14,000 lbs. each, or about one-third the estimated weight of fittings made in cast iron; that of the T was about 11,000 lbs,—the saving in this case being about the same.

THE OPENING OF THE ASTORIA TUNNEL

By the Consolidated Gas Company of New York.

An esteemed correspondent has forwarded the following vivid account of a big engineering feat which has been successfully undertaken by the Consolidated Gas Company of New York and its subsidiary concern the Astoria Light, Heat, and Power Company, at Astoria (Long Island). The work referred to was the boring of a tunnel under Long Island Sound, between Astoria and the borough of the Bronx, a rapidly developing section of New York City. As will be seen, the tunnel was opened on the 17th ult.; and the description and figures constitute a valuable record of operations, on the successful completion of which all concerned are to be heartily congratulated.

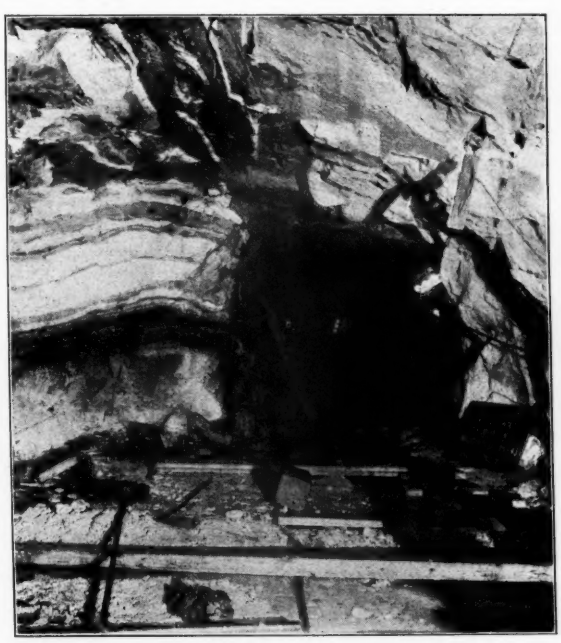
GENERAL VIEW LOOKING THROUGH THE TUNNEL.

One of the most stupendous pieces of tunnel engineering, especially for gas purposes, has just been accomplished by the Consolidated Gas Company of New York and its subsidiary Company, the Astoria Light, Heat, and Power Company, at Astoria (Long Island). The opening of the tunnel has been accomplished; but the work of this gigantic undertaking is far from being completed. It will probably be at least another year before two gas-mains, each 72 inches diameter, will have been laid through the tunnel.

One may obtain a fairly accurate idea of the immensity of this piece of work by a cursory reading of, and glance at, some of the figures. Work was begun on the tunnel on Sept. 12, 1910; and it was not "holed through" until Thursday, the 17th ult., at about 3.35 o'clock in the afternoon. The bore of the tunnel is practically this shape ⏀—very much like the letter D. The tunnel is 21 feet high and 19 ft. 9 in. in width. The concrete lining, where concrete is used, varies between 18 and 36 inches. Where necessary, the concrete is reinforced with steel rods. The mean depth of the floor of the tunnel is 246 feet, and over the tunnel roof there are 90 feet of water and about 135 feet of solid rock, for the tunnelling was done through solid rock. When one travels through the tunnel, as did the correspondent of the "Journal," one is 246 feet below the surface of the water. It was not surprising, therefore, that the daily papers throughout the United States devoted considerable space to the ceremonies attending the "holing through" on July 17.

It should be understood that the tunnel runs in almost a direct north and south line, between Astoria and the borough of the Bronx, the northernmost section of New York City—a section that is developing very rapidly. Only as recently as 1890 the population of the Bronx was 88,908. In 1900, it was 200,507; ten years later it was 430,980; now the population is 531,219. In such a rapidly-growing territory, it may readily be seen that the future, as well as the present, must be provided for; and it is for this very purpose that the tunnel, representing an expenditure, it is said, of nearly $5,000,000, and the laying of these two 72-inch mains, was undertaken. Was it any wonder that Mr. William H. Bradley, the veteran Chief Engineer of the Consolidated Gas Company of New York, breathed a sigh of relief when he and Mr. George B. Cortelyou, the President of the Company, simultaneously touched electric keys that rent asunder 3 feet of rock which divided the two tunnel borings under the waters of Long Island Sound? For, mind you, this was another of Chief Bradley's successful culminations of stupendous undertakings.

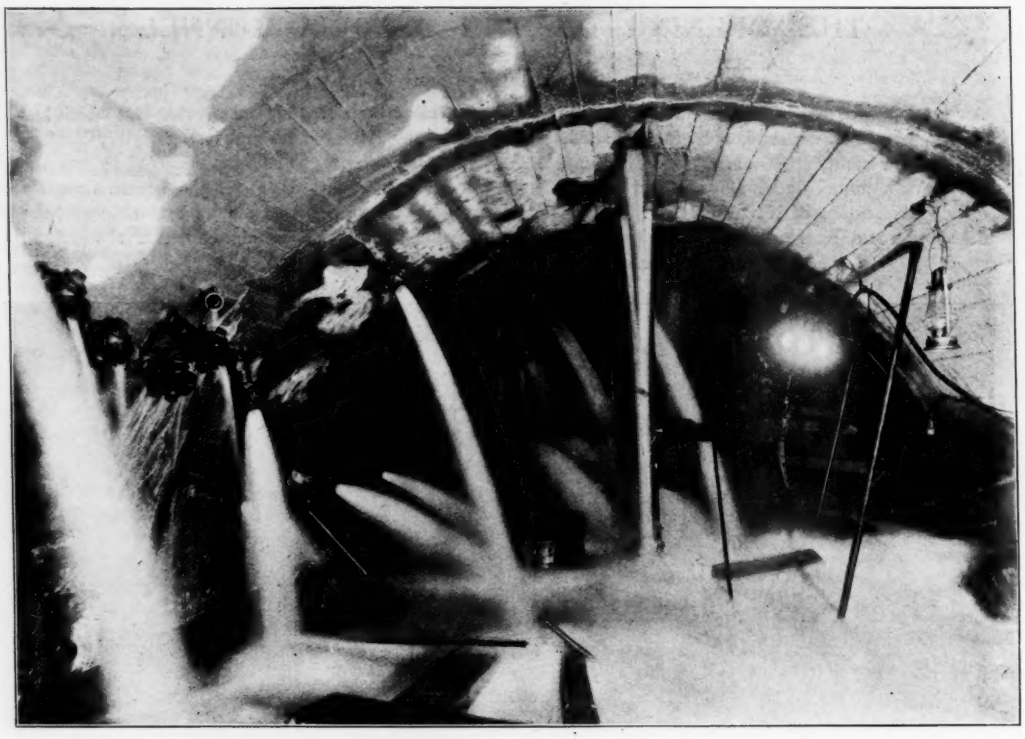
Each one of the 72-inch mains is 2½ inches thick. It is built in sections, of course, of 12 feet length; and each section weighs a little over 13 tons. In other words, the immense gas-pipes weigh something more than 1 ton to the foot. Eventually it may be necessary to place two more of these mains in the tunnel; making four altogether. It will take about six months to lay the two mains; and it will probably be six months before the tunnel will be ready to receive them. The shaft leading to the tunnel on the Astoria end is 276 ft. 9 in. deep, and the shaft on the Bronx



The Rock Formation through which the Tunnel is Bored.

end is 233 feet in depth. The total distance the tunnel runs, including the shafts, is practically a mile—5171·79 feet, to be absolutely accurate. The diameter of the Astoria shaft is 34 ft. 6 in., while that of the Bronx shaft is 26 feet.

On July 17 there were but 3 feet of rock to be removed, to join the tunnel ends running from the Bronx and Astoria. This had

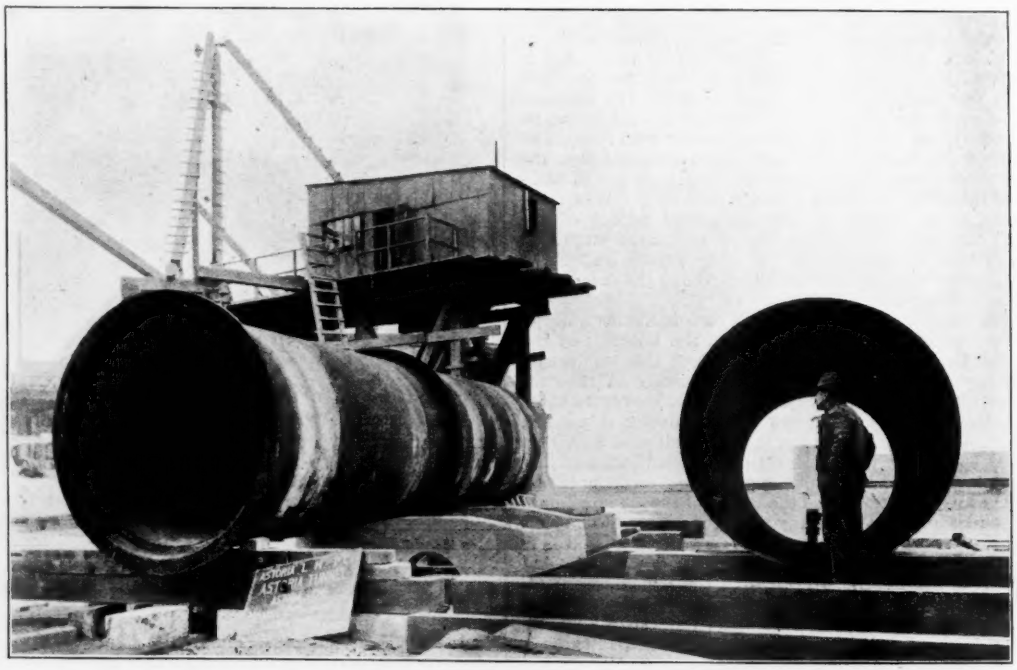


SHOWING HOW THE WATERS OF THE SOUND HAD TO BE TAKEN CARE OF WHEN THE WATER POURED THROUGH PLACES WHERE DISINTEGRATED ROCK WAS ENCOUNTERED.

For a time this leakage resulted in the water being 6 feet deep.

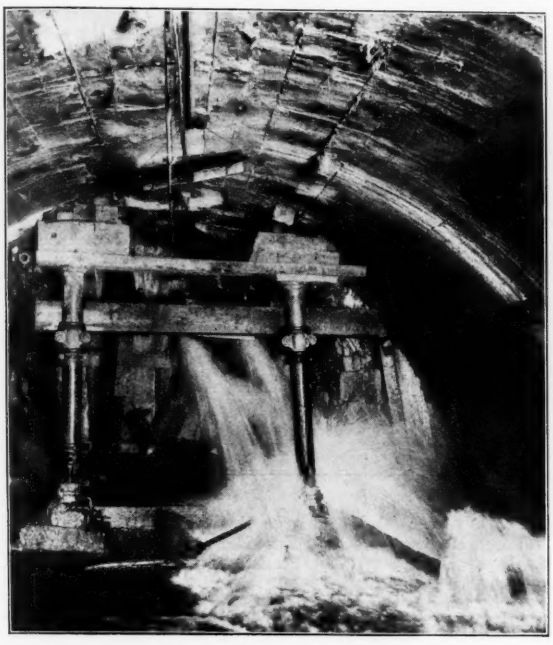
to be blown out by dynamite discharged by electricity. The wall of rock was 800 feet from the Bronx shore. As already stated, the electric current was set in action by Mr. Cortelyou and Mr. Bradley. There were about thirty witnesses of this interesting scene 246 feet below the surface of a seething body of water. Among those in the gathering were Mr. Lewis B. Gawtry, the Vice-President of the Consolidated Gas Company of New York, and a son of Mr. Harrison E. Gawtry, for many years President of the Company, and now Chairman of its Executive Board; Mr. Nicholas F. Brady, a son of Mr. Anthony N. Brady, and now President of the New York Edison Company; Mr. J. W. Lieb, jun., and Mr. Thomas Murray, Vice-Presidents of the New York Edison Company; Mr. W. Cullen Morris, Deputy-Engineer of Construction; representatives of the Contractors, Messrs. Jacobs and Davies, Inc.; Mr. Robert E. Livingston, of the Consolidated Gas Company of New York; and sixteen or eighteen newspaper representatives. The entire party entered the tunnel at the Astoria end, and, after the opening in the rock was made, emerged from the Bronx end.

The work of building the tunnel has gone forward quietly, and comparatively few persons were even aware that it was under way. There has been no advertisement of the magnitude or the difficulties of the job. The men who engineered the work and drilled and blasted their way through the rock, far under the river bottom, were there to build the tunnel and to fight the water which occasionally entered under full head. Ground was broken for the vertical shafts at the tunnel ends on Sept. 12, 1910, and since Feb. 12, 1911, work on the tunnel proper has been pushed forward. On the Long Island side, the shaft is located at the foot of Winthrop Avenue, Astoria, opposite One Hundred and Twentieth Street, New York; and the Bronx shaft is at the foot of One Hundred and Thirty-Second Street, where Stony Point juts into



SECTIONS OF THE 72-INCH MAINS (THE LARGEST IN THE WORLD) THAT ARE TO RUN THROUGH THE TUNNEL.

The main on the left of the picture shows how the mains will rest on cradles.



A Bulkhead that had to be Constructed at the Astoria End of the Tunnel with the Waters of the Sound pouring through.

the stream. The course of the tunnel is almost north and south for its full length of 4662 feet. The tunnel, it will be observed, does not pierce the immediate bed of the river after the manner of the various subaqueous railway tubes in the vicinity of New York, but penetrates at a very deep level the rock which at the Astoria and Bronx ends was a gneiss, with a band of limestone between.

Excellent progress was made through the gneiss rock on either side, and through the limestone at the Astoria end. However, in crossing the contact between the two rocks at the Bronx end, great difficulties were encountered. The contact was not pronounced; and a great body of water being met with at this point, 750 feet from the New York side, work from this end was then discontinued. Progress was made rapidly from the Astoria end for a distance of 3500 feet, when difficulty was again encountered, due to entering the contact between the gneiss and limestone strata. A very disturbed formation existed here, layers of sound rock alternating with fissures of highly-disintegrated rock; the latter resembling a greenish sand, bearing water under full head.

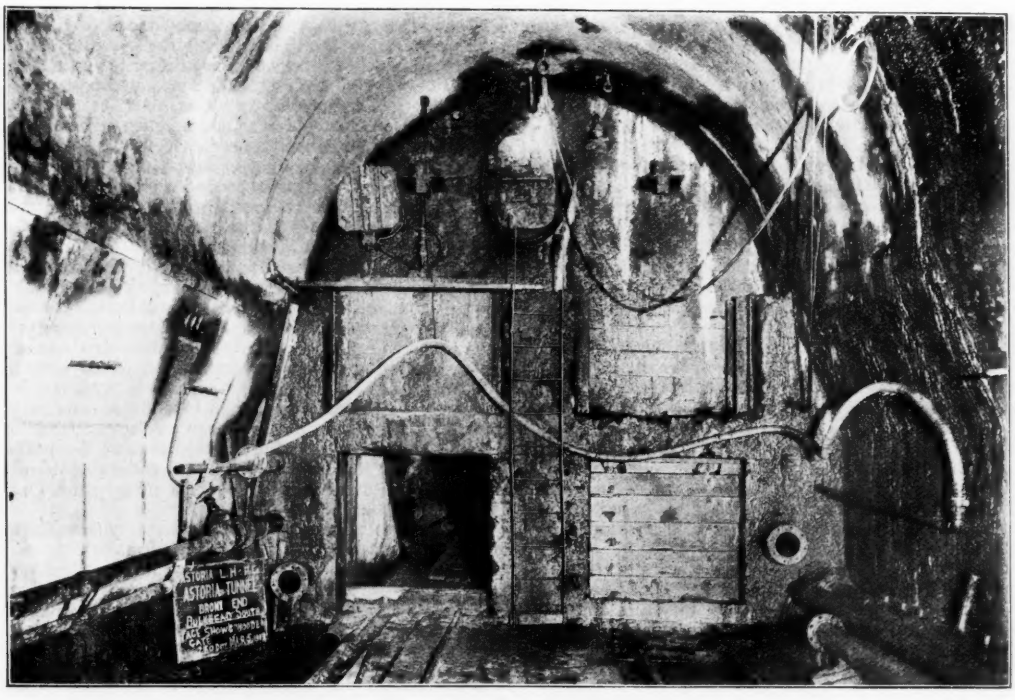
Owing to the great depth of the tunnel, the use of compressed air as an aid to fight the incoming water, as is common in tunnels of shallow depth, was impossible, as it would have required some 110 lbs. pressure per square inch above the normal to hold the water; whereas 40 lbs. pressure per square inch above normal is considered quite high for men to work in. Therefore great care was exercised in the driving of the tunnel through this belt. Before advancing the heading, in every instance a thorough exploration of the rock next to be met with was made, by drilling test-holes of greater depth than the customary drill-holes. When water was encountered, it was allowed to run and carry with it the sand in the fissures penetrated, and thus create a void into which "grout"—a liquid cement—could be forced under great pressure, and thus fill them with the grout, which, when set, formed, as it were, an artificial rock. There were occasions also where, after advancing the heading, a seam would break away and allow the water to come in. To cope with this, it was necessary to construct a wall of concrete to reinforce the rock, in which were placed suitable pipes for the water to come through until free of any suspended material, and then in turn be used to inject the grout. So great was the flow at times that one single leak gave 4000 gallons of water per minute; and about as high as 4800 gallons of water per minute for a period of 24 hours has been pumped. The area of the fissures can also be gauged from the fact that as much as 1000 barrels of cement has been forced into a single fissure under a pressure of 500 lbs. per square inch.

The work involved the exercise of extreme caution, and was consequently tedious and slow, as one could not fortell what was ahead. On one occasion in the Bronx heading, where the grade was descending from the shaft, making the face the lower of the two, the influx occurred without warning, flooding the tunnel to a depth of 6 feet at the face, and making it necessary for the men to use improvised boats in order to reach the face to construct a bulkhead. The trouble zone extended for over 400 feet; and if this had not been encountered, the entire work would have been completed early in 1912. The 400 feet of bad rock delayed the completion of the tunnel more than a year, and added greatly to the cost of the undertaking.

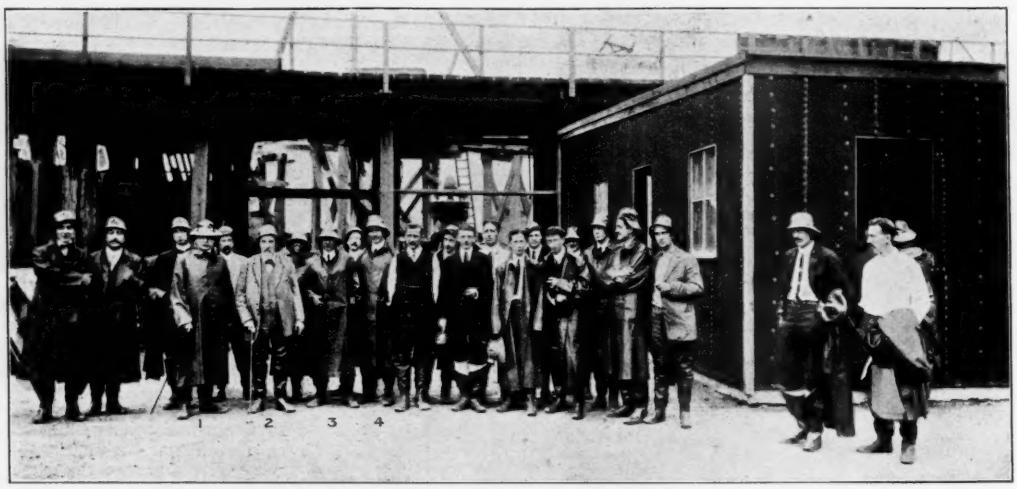
As shown by the collection of minerals made during the progress of the tunnel building, the geological features of the work were very interesting. Samples of asbestos-like material, about ¼ inch thick, were found between layers of rock in sheets extending practically across the tunnel. At one point where large volumes of water were encountered, there came through into the tunnel with the water hundreds of fish, which the workmen caught with their hands in the water flowing on the bottom of the tunnel.

The entire work of engineering, organization, and construction was carried out under the general direction of Mr. William H. Bradley, Chief Engineer, and Mr. W. Cullen Morris, Engineer of Construction, for the Astoria Light, Heat, and Power Company, by Messrs. Jacobs and Davis, Inc., who designed and engineered the Pennsylvania Tunnels under the Hudson River, designed, engineered, and constructed the M'Adoo Tube System, and have done other similar work in various parts of the world. Mr. Vivian Messiter had charge on the ground for Messrs. Jacobs and Davies. The old East River gas-tunnel from Ravenswood (L.I.), which is now in use, was also built by the same firm.

[Readers will be particularly interested in the photograph on p. 366—the group of officials, engineers, and newspaper men, after



AN EMERGENCY BULKHEAD THAT HAD TO BE CONSTRUCTED AT THE BRONX END OF THE TUNNEL.



emerging at the Bronx end of the tunnel, subsequent to the "holing through." In the front rank, many on this side will recognize the portraits of the gentlemen connected with the Consolidated Gas Company of New York, beneath which figures are placed. They are: (1) Mr. George B. Cortelyou (President), (2) Mr. William H. Bradley (Chief Engineer and General Manager), (3) Mr. Lewis B. Gawtry (Vice-President), and (4) Mr. Robert E. Livingston.]

ARTIFICIAL DAYLIGHT FOR COLOUR MATCHING.

By Robert ffrench Pierce.

The following is a description of the principles involved in the design and operation of the Ives Artificial Daylight Producer, with particular reference to utilizing the incandescent gas-lamp as a primary source of light. The small amount of publicity which the apparatus has received in this country has resulted in considerable interest being displayed, especially in the textile trades; and this application of gas lighting in an entirely new field will certainly appeal to "Journal" readers.

Wherever discrimination between, or matching of, colours is necessary, there are often deceiving, and sometimes almost unbelievable, errors introduced by the light by which the colours are viewed. Not only do all the artificial lights—no matter how white they may appear to the eye—distort colours from their so-called "daylight" values; but the north-sky itself (the most uniform of natural light sources) is notoriously unreliable. A match made under a cloudless north-sky may, with some delicate colours, prove far from a match under a cloudy sky. Furthermore, the modifications of north-sky light introduced by reflection from green foliage, red-brick buildings, &c., often prove so deceptive that a match made in one portion of a plant may not be duplicated in another.

This deficiency in natural light is, perhaps, best understood, because most plainly in evidence, in the dyeing of textiles in which delicate and complex dyes are used; but lithographers, engravers, printers, colour-grinders, paper-makers, &c., often find that, even with the less sensitive mineral pigments, the sky is by no means a dependable light source for colour matching. No less frequently is the purchaser of dress goods, printed matter, stains, paints, &c., disappointed over the results of matching samples under artificial light, or under daylight distorted by reflections from surrounding buildings, &c.

While it is true that not all fabrics or coloured objects are to be worn or displayed under daylight, or even under approximately white light, it is obvious that matching may be best done under the particular kind of light originally used by the dyer or colour maker. Subsequent estimates of the appearance of the fabric or object under any artificial light may be made under the particular light required; but this operation is far more deceptive than is usually supposed. For instance, it might be thought that material for a ball-gown might well be matched under electric incandescent light; but if the match be made under tungsten lamps in a store, and the gown be worn in a ball-room lighted by small low-efficiency carbon filament lamps such as are often used for decorative or artistic lighting effects, the result is apt to be anything but pleasing.

Since manufacturer, retailer, and user of fabrics and materials in which colour is an important feature have long suffered from the lack of an artificial light duplicating daylight, and at the same time eliminating its unreliability from the standpoint of colour, it is believed that a description of a new and successful solution of this problem will prove interesting.

The colour of a fabric or other material, as apparent to the eye, depends upon two things—the composition of the light by which it is illuminated, and the property of the material itself of absorbing light rays of certain colours. The latter may be controlled by the use of paints, dyes, &c.; but these only serve to cause the material to display the same hue under light of the same composition.

It should be clearly understood that it is the *composition*, not the colour alone, of the light that is of importance. Similarity of colour does not necessarily imply similarity of composition. For instance, the composition of sunlight, or white light, from the calcium light or the open electric arc, is quite different from that of white light made by the mixture of red, green, and blue light.

If we split sunlight up into its component parts or spectrum (fig. 1) by means of a glass prism, we see that this spectrum is a continuous band containing six colours—violet, blue, green, yellow, orange, and red—each shading almost imperceptibly into the adjacent ones. If, however, we split up in the same manner a white light made by mixing red, green, and blue light, we obtain the spectrum shown in fig. 2, containing only three narrow lines. If sunlight be thrown upon a surface which absorbs red rays only, the spectrum of the reflected light will be identical with that of the original light, except that the red portion will be lacking (fig. 3). If the same surface be illuminated by a white light made by mixing red, green, and blue light, the resulting spectrum will contain only the narrow blue and green bands (fig. 4). Since it is the composition of the light entering the eye that determines the colour perceived, it is possible for a fabric to appear of one colour under one kind of white light, and of quite another colour under a white light of different composition.

To match colours under artificial light so that they will also match under daylight, it is necessary to provide artificial light having the same composition as daylight. No ordinary commercial source of artificial light produces a light even remotely approaching daylight in composition. This may be readily seen from fig. 5, which shows the distribution in different portions of the spectrum of light from several well-known artificial light sources. The incandescent gas-lamp, the incandescent electric lamp, and the acetylene flame contain all the colours found in daylight, but in vastly different proportions. Others, like the mercury vapour lamp, emit light containing one or two colours. As practically an infinite number of colour gradations or shades are present in daylight, the duplication of daylight by mixing together various colours of light separately produced is quite impracticable. The other expedient is to utilize some artificial light containing all the colours present in daylight, absorbing or filtering-out the excess of different colours *above* the proportions in which they are found in daylight, so that the remaining light will be an exact duplication of daylight in composition, and hence in effect.

It would appear from the curve that only (say) 80 per cent. of the light from the Welsbach mantle would thus require absorption to bring the remainder to daylight composition. It is not possible, however, to absorb the excessive or undesirable rays alone without also absorbing a certain portion of the rays in which the light is already deficient; and for this reason the practical use of this method involves a sacrifice of 90 per cent. of the total light produced. With other artificial light sources, however, even a greater proportion must be wasted; so that the Welsbach mantle is by a large margin the most economical means of producing artificial daylight.

Fig. 1

Fig 3

Fig 2

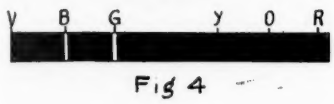


Fig 4

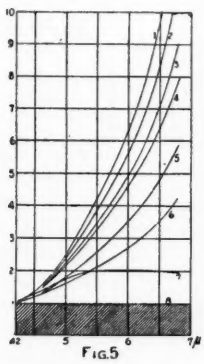


Fig. 5

Curve showing amount of spectra of various light sources which must be absorbed to give white light.
Shaded area—White light.
1. Glow lamp, carbon, 4·85 watts per M.S.C.P.
2. ,, ,, ,, 3·75 ,, ,, ,,
3. ,, ,, metallized, 3·1 ,, ,, ,,
4. ,, ,, tantalum, 2·6 ,, ,, ,,
5. ,, ,, tungsten, 1·58 ,, ,, ,,
6. Acetylene.
7. Welsbach mantle, ¾ per cent. cerium.
8. Daylight.

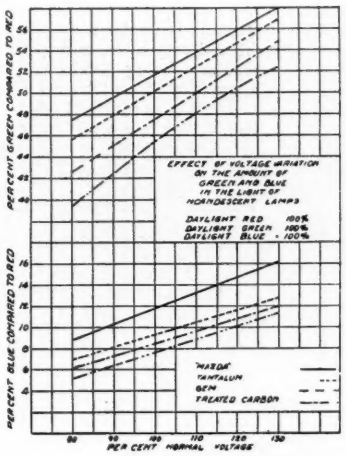

EFFECT OF VOLTAGE VARIATION ON THE AMOUNT OF GREEN AND BLUE IN THE LIGHT OF INCANDESCENT LAMPS
DAYLIGHT RED 100%
DAYLIGHT GREEN 100%
DAYLIGHT BLUE - 100%
PERCENT GREEN COMPARED TO RED
PERCENT BLUE COMPARED TO RED
PER CENT NORMAL VOLTAGE
MAZDA
TANTALUM
GEM
TREATED CARBON

Fig. 6

The light from incandescent electric lamps and incandescent gas-lamps varies considerably in composition according to the material used. In the gas-mantle, particularly, light ranging in colour from purple at one end of the spectrum to red at the other may be obtained by varying the proportion of ceria. The efficiency of light production varies at the same time.

Since all absorbing screens which filter out the excessive amounts of red, orange, and yellow rays also absorb to some extent the blue and violet rays in which the artificial light is already deficient, it is desirable to start with as close an approach to daylight as possible, thus reducing the amount of absorption necessary and conserving the small amount of blue and violet light present in the original light. Coloured screens for absorbing different colours of light may be made of properly coloured glass, or of clear colourless glass bearing a film of gelatine containing properly selected dyes. Coloured glass is almost impossible to secure of sufficiently uniform thickness and quality. On the other hand, no dyes available will absorb or filter-out the long, dark red rays which are present in great excess; while certain blue-green glasses perform this service very effectively.

The best results are therefore secured by first filtering the light through a screen of blue-green glass to remove the excess of long, red rays, and then passing it through a second filter of dyed gelatine carried on a plate of colourless glass to remove the excess of other rays remaining. Since the composition and density of the dyed gelatine film is easily controlled, exact correction may be made for any non-uniformity in the blue-green glass screen with which it is "paired." This "pairing" is performed by spectrophotometric analysis of the light passing through the two screens, and comparison with the spectral distribution of average daylight as previously determined. The resulting light is identical with *average* daylight. It is only by means of these highly-refined methods that a reliable and uniform light for colour-matching may be produced.

The first successful practical application of the absorption method of producing artificial daylight was by Dr. H. E. Ives, who carried to a commercially satisfactory conclusion the difficult and laborious research and experimental work on which the solution of the problem depended. The results of his early experiments were embodied in practical form a few years ago in an artificial daylight producer utilizing the tungsten lamp as the original light source. Later research indicated the possibility of a closer approach to average daylight than was obtained with the earlier device; and the results of his recent investigations have been applied to the construction of a device in which the faults of the earlier apparatus are eliminated, and which may be used either with the Welsbach gas-lamp or with the tungsten electric lamp—the only difference being in the dyes that are employed upon the second screen.

The gas-mantle is preferable to the electric source, however, since the light from the latter changes in composition with burning and with different voltages, while the gas-lamp suffers no changes of a corresponding nature. Fig. 6 shows the variation in the proportions of green and blue light respectively (with relation to the red) under different voltages. As voltage fluctuations frequently occur on electric lighting circuits, a variation in the quality of the resultant light is encountered.

The Welsbach mantle is of a special composition which maintains a uniformity in the colour of light emitted throughout life, and is in itself a much nearer approach to daylight than any other artificial incandescent light source. This reduces the loss of light through absorption—a very important matter, as even with this mantle it is necessary to absorb 90 per cent. of the original light. Since the resulting artificial daylight is comparatively expensive at best, the desirability of utilizing economical light sources with which the least loss through absorption is attended is obvious.

A further advantage of the use of the Welsbach mantle lies in the fact that different mantles may be furnished which, in the same apparatus, enables an exact duplication of either average north sky light or direct sunlight. By this means, the variation in hue or match between these two extremes of daylight may be determined without dependence upon outside weather conditions.

SOUTH AFRICAN COALS FOR GAS MANUFACTURE.

By J. W. Brown.

Having only recently returned from South Africa (arriving in this country in May), where I have had charge of affairs for the South African Lighting Association, at their works at Port Elizabeth, Algoa Bay, and Grahamstown, during the absence on extended leave of their Resident Manager, and having been successful in finding gas-making coals out there, perhaps a little information on South African coals, their analyses, and results from a gas-making point of view may be of interest.

Owing to the high price of imported English coal—costing into the works at Port Elizabeth over 38s. per ton, and into Grahamstown more than 57s.—and the fact that coalfields are being found all over South Africa, my Directors wished me to give special attention to testing these coals, and if possible find one which it would be advantageous to the Association to use.

Shortly after my arrival in the Colony (after I had given myself time to look around), I called upon several agents, and wrote to all the collieries I could hear of, for analyses and prices.

While waiting for these to arrive, I made a careful test of the English coal we were using (Aldwarke Main washed nuts) for the purpose of finding what could be obtained per ton, for ultimate comparison against colonial coal, so that only coals which would give us a profit by substituting would receive final consideration from me.

After a prolonged test, I found the yield per ton from this coal to be just over 12,400 cubic feet of 16-candle power gas, with 10 gallons of tar, and slightly over 800 lbs. of coke available for sale. [This latter was after allowing coke for furnaces, and that used on the works for the boiler, and by the Kaffir boys for any cooking they did.] As coke realizes 45s. per ton of 2000 lbs., and tar 1s. per gallon, it will be seen that these items are very important. Ammonia I did not take into consideration, as beyond what we made and sold as "S.A.L.A. Cloudy Ammonia," it is practically unsaleable.

In looking at any results obtained, it must be remembered that the retorts are singles, not back to back, and only semi-regenerators at Port Elizabeth, with direct-fired at Grahamstown, and that only native labour is employed.

The replies I received from the various colliery agents indicate that anything from slaty shale to good coal is to be obtained; and I chose for first testing from over sixty various analyses the following three Natal coals,

Burnside, Ballengeisch, and Hlobane.

I place Burnside first on the list, as I had had an opportunity of seeing this coal, and it struck me from its appearance that it should be a fair gas coal. This surmise subsequent investigation proved to be a correct one.

The chemical analyses from the three forementioned collieries are as follows [these are copied from the originals]:

	Burnside. Per Cent.	Ballengeisch. Per Cent.	Hlobane. Per Cent.
Moisture	1·06	1·5	0·60
Volatile hydrocarbons	21·63	27·2	28·40
Fixed carbon	68·30	71·7	62·49
Ash	10·50	10·8	7·84
Sulphur	1·17	1·6	1·01

My report on these coals is as follows:—

Burnside.—This coal is a dull black, with thick streaks of bright resinoid bituminous coal. Fracture is irregular. On the fire, it burns bright and very even, and gives off a very white gas. The coke is excellent—being good grey in colour and fairly hard. Burns with great heat, and leaves little clinker. What there is being fairly soft, burns to a whitish grey ash.

Ballengeisch.—This is a hard, dirty looking dull black coal, with fair amount of bright bituminous streaks, irregular in fracture, with traces of calcic carbonate. Coke, &c., similar to Burnside.

Hlobane.—This coal is a very heavy dull black, with very little bright streaks through it. Irregular in fracture. Gives off a very even quantity of gas, of fair quality, through the greater part of the eight-hour charge. The coke is very hard and heavy, from grey to black in colour, slow in burning, but with good heat, certainly the best coke of all the colonial coals I have tested. Leaves little clinker, and burns to a grey ash.

Practical Results.

	Burnside.	Ballengeisch.	Hlobane.
Gas per ton, cubic feet	10,500	8934	9401
Illuminating power, candles.	16	15	15
Coke for sale, lbs. per ton	900	950	1050
Quality	Excellent	Good	Good hard
Combustible matter in coke, per cent.	86	84	86
Ash, per cent.	14	16	14
Tar, gallons.	5½	9	8

These coals were the ordinary round, and not washed or picked at all. When the washing plants (now in course of erection) are completed, no doubt results will be improved.

Regarding the coals from the Transvaal, I do not think (after the many tests I have made) that there is yet any good gas-making coal to be obtained in bulk. I am aware that the Municipality of Johannesburg purchase for their gas-works a quantity of coal from the Coronation Colliery, Witbank; but this is specially picked for them, and at fairly high prices. The coal gives very good results; but the collieries are not too keen upon supplying much, as it reduces the (already too poor) quality of the remainder. After comparing prices and the results of this hand-picked coal, against the results I obtained from Burnside, I would not dream of recommending it for use.

From the many collieries in the Transvaal and district, the following are the best results I could obtain:—

Practical Results.

	Witbank.	Coronation.
Gas per ton, cubic feet	10,030	7853
Illuminating power, candles	15	15
Coke for sale.	Not good enough	Not good enough
Combustible matter in coke, per cent.	83	80
Ash, per cent.	17	20
Tar, gallons	8½	8½

These results are per ton of 2240 lbs.

After much careful and prolonged testing among these coals, I feel certain that the best coals for gas making will be found in the Natal group; and of these "Burnside," belonging to the Dundee Coal Company, is undoubtedly the best and most profitable to use. I am giving away no secret when I say that, as the direct result of my investigations and researches into South African coal, the Directors of the South African Lighting Association have made contracts for this coal (the first ever made in South Africa for ordinary round coal for gas making), which will undoubtedly prove of great financial advantage to them.

As readers in South Africa may wonder what other coals I tested, I may add that, among others, I tried St. Georges, Cambrian, and Newcastle of the Natal group, and Breighton and Vaalbank of the Transvaal. Many others were tried; but the results obtained are not worth recording here.

Since returning to this country, I hear that, owing to the cost of coal rising and freights increasing, the saving to South African companies through using colonial coal will be greater in the future than ever before.

Irish Association of Gas Managers.—The annual meeting of the Association will be held in the City Hall, Belfast, next Tuesday, under the presidency of Mr. W. H. Roberts, the Gas Engineer and Manager to the Newtownards Urban District Council. According to the programme issued by the Hon. Secretary and Treasurer (Mr. George Airth, of Dundalk), the members will be welcomed by the Lord Mayor (Mr. R. J. M'Mordie, M.A.), and afterwards the usual preliminary business will be disposed of and the President will deliver his Inaugural Address. The technical items are a lecture by Mr. Jacques Abady on "British Thermal Units," and a paper on "High-Pressure Lighting on the Selas Principle," by Mr. A. Docking, of Manchester. On the invitation of the President, the members will partake of light refreshments; and Mrs. Roberts will entertain their ladies at a light luncheon. In the evening, the usual dinner will be held at Thompson's Restaurant, Royal Avenue. By permission of the Chairman of the Gas Committee of the Belfast Corporation and the Engineer and Manager of the gas-works (Mr. James D. Smith), members will be able to visit the works and see the vertical retorts in action. In the evening, the high-pressure compressing station at the City Hall will be open to all the members. Next day there will be an excursion to Bangor, for Ballywalter and Newtownards, *viâ* Donaghadee and Grey Abbey.

REFRACTORY MATERIALS AND TEMPERATURE TESTS.

By J. W. Mellor, D.Sc.

It is really a curious phenomenon, and one not without its humour, how very much Seger cones are absolutely misunderstood. Some one periodically discovers, about every other year, that the cones are 200° more or less out when compared with a thermo-electric, a Féry, a Wanner, or some other pyrometer. On the other side, the literature of clay-working is suffused with warnings that Seger cones can be used as temperature indicators only under certain rigorously defined conditions. The tailor might almost as reasonably use his shears to measure a customer for a suit of clothes as for a gas engineer to employ Seger cones to measure the temperatures *per se* of his retorts. I send you herewith some notes published in 1910 bearing on the use of these cones; and I may in a subsequent article give you my views on the remarkable transmutation of clay into iron which is taking place daily at certain gas-works—thus converting good fire-clays into fusible ferruginous slags!

The following are extracts from a paper summarizing some of the principles which have been largely emphasized in the County Pottery Laboratory, Staffordshire, during the past few years.

Influence of Time and Temperature on the Speed of Vitrification of Clays.

We are generally agreed that the chemistry of clay working is, to a great extent, a chemistry of arrested reactions. In a general way, certain constituents are mixed together, and the mixture is heated. Some of the constituents begin to fuse, binding or cementing other constituents together. The molten fluxes, generally felspathic, dissolve some of the less fusible constituents, quartz or flint and clay. When the action has progressed far enough for a particular effect, the mass is cooled, and the reaction* is stopped. This principle applies to the act of vitrification of bodies, glazes, enamels, &c. By "vitrification" I here include, not only the formation of the glass due to the melting of the crystalline and other fluxes, but also the solution formed by the solvent action of the fluxes on the quartz, flint, clay, &c. In the fired body we have particles of undissolved clay, flint, quartz, &c., apparently embedded in a glassy, vitreous matrix.

The process of vitrification is a time-reaction, and the velocity of the reaction is accelerated by raising the temperature. Much of the work done during protracted firing at a low temperature can be performed in a shorter time at a higher temperature. Thus two or more "easy" firings will very frequently produce the same contraction, translucency, &c., as one hard firing. If two blocks be made from the same clay, and one be heated (say) twelve hours at 1000°, it may only have attained the same state of vitrification as is produced by heating the other block two hours at 1100°.†

It is therefore obvious that if a fire-clay be reported to soften at (say) 1700°, this number means very little if the rate of rise of temperature be not also indicated; and the softening temperatures of different clays cannot be compared if the rates of rise of temperature be not the same.

It has been found empirically that if the firing occupies a certain interval of time, a certain cone collapses near a certain temperature; and therein lies the peculiar advantage of cones as a standard of comparison. A cone does not directly indicate temperatures at all; and all attempts to connect the squatting of cones with definite temperatures must prove abortive unless the rate of rise of temperature be fixed. The softening temperature obtained for one rate of rise of temperature will not correspond with the temperature determined for another rate of rise of temperature. If the clay be heated in the furnace side by side with cones, the softening temperature of the clay, represented in terms of Seger cones, tells us that the reactions between the constituents of the cones and between the constituents of the clay have progressed far enough to lead to the squatting of both. If cone and clay be heated slowly, the result would be different from what would be obtained if clay and cone be heated quickly. Cone No. 5, for instance, collapsed when heated one day at 1130°, and No. 1 when heated five days at the same temperature.

The following fact has been cited as a puzzle: The fire shrinkage of "trials" fired comparatively rapidly in a muffle about four hours was regularly reported greater than the fire shrinkage of a similar body fired to the same temperature in the ovens on a large scale. Upon investigation, it was found that the temperatures were determined by Seger cones. A piece of ware fired to cone No. 8 in four hours has been heated to a higher temperature than a similar piece heated below dull redness for a few days, and gradually heated to No. 8 for another three days. Indeed,

* The word "reaction" is here employed in a general sense for changes, physical or chemical, which occur during vitrification.

† It is also easy to see how modifying the rate of firing a glost oven or enamel kiln may change the rate of attack of colours by glaze, and so produce different results. If the dehydration changes are too rapid, the expulsion of water may proceed with explosive violence, and ruin the product. My remarks are here confined to vitrification.

the maximum temperature of the rapidly fired piece may have been more than 100° higher than the slowly fired piece. The experimental results show that the vitrification of the body progresses more when heated to the higher temperature for a short time than when heated for a long time at the lower temperature under conditions where the work done on Seger cones is apparently the same. The conditions for measuring the speed of the reactions under the different conditions are not the same. The two reactions (cone and clay) may be such that they have the same speed at one temperature, and yet at another temperature their speeds may be different. This is probably due to the different temperature coefficients of the two reactions—(1) vitrification of cone, and (2) vitrification of clay. We have no particular reason for assuming that the two reactions have the same temperature coefficient, beyond a more or less remote analogy between cone and clay.

The subjoined experiments by Mr. S. T. Wilson, admirably illustrate the influence of time and temperature on the rate of vitrification. The progress of the reaction in the firing of bone china (cast) is approximately indicated by the dry to fired contraction indicated in the last column of Table I. and the middle column of Table II. The wet to dry contraction was 5·3 per cent.; the maximum fire contraction, 11·8 per cent. Any further heating leads to a decomposition attended by an evolution of gas. The ware begins to expand if fired to higher temperatures.

TABLE I.

Time in Hours.	Estimated Temperature by Cones. Deg. C.	Contraction. Per Cent.	Time in Hours.	Estimated Temperature by Cones. Deg. C.	Contraction Per Cent.
24·0	990	0·8	38·5	1190	6·2
28·0	1050	1·0	38·5	1210	8·8
32·0	1110	2·6	39·0	1230	9·2
33·5	1150	2·6	40·3	1250	10·6
35·0	1170	6·2	40·75	1270	11·0
35·75	1190	6·2	Cool	1290	11·8

The same ware fired in a glost oven to between cones Nos. 01 and 1—estimated temperature 1130° to 1150°—for approximately 20 hours, gave the following results:—

TABLE II.

Times Fired.	Contraction Observed. Per Cent.	Contraction Calculated from Theory. Per Cent.	Times Fired.	Contraction Observed. Per Cent.	Contraction Calculated from Theory. Per Cent.
1	3·2	..	5	5·8	6·2
2	4·0	3·9	6	6·8	6·7
3	5·0	4·9	7	7·6	7·4
4	5·6	5·7	8	8·0	7·9

Although Mr. Wilson gave me no more figures, he says that after the twelfth firing the result—contraction and translucency—resembled that obtained at cone No. 8—estimated temperature 1290°—with 41 hours' firing.

The evidence is clear so far as the reaction between the constituents of the body is concerned; a protracted firing at a low temperature will do the work of a short firing at a high temperature. If the time of firing an oven be diminished, the temperature must be raised in order to carry the reaction as far as it would progress at the lower temperature for a longer time.

It is a fallacy to assume that, when (say) a fire-brick is "burned" at a higher temperature than that of the furnace in which it is to be used, the brick has ceased contracting. Everything points to the conclusion that the internal changes will continue, and the brick will go on contracting for a long time, whenever its temperature is raised to "*le point de réaction.*" Obviously, the speed of the reaction slackens-down with each successive firing. Hence, if bricks are well fired at temperatures equal to or, better, exceeding those at which they are to be used, subsequent contraction, with ordinary fire-clays, will not be very great. Conversely, if the bricks be "burned" at a temperature below that at which the bricks are to be used, the subsequent contraction may be great enough to very seriously disturb the masonry of a furnace, oven, or kiln.

Influence of Texture (Fineness) on the Rates of Vitrification.

Every condition which will accelerate the reaction will favour rapid vitrification. The finer the texture of a body, the more rapidly will the reaction occur. Hence fine grinding means rapid vitrification. Of a number of clays with the same mineralogical and chemical composition, those will vitrify quickest which are the more finely ground. We must be careful how we understand "below 1000° only the finest particles of silica can enter into combination, and so act as a flux, but at higher temperatures much larger particles of silica may do so," since it is not literally correct. The fact is, if fine particles of silica can enter into combination and act as a flux at 1000°, large particles may do so; it is all a question of speed. Fine-grained silica (flint) dissolves in the vitrified fluxes more rapidly than coarse grained silica. Similarly, overgrinding leads to rapid vitrification, and by so producing a body of unusually close texture leads to "dunting," as well as to other faults. Other things being equal, a fine grained texture means rapid vitrification; and in the case of fire-bricks, rapid vitrification means decreased refractory qualities. Conversely, a coarse-grained texture means slow vitrification and increased refractory qualities. It is thus easy to see how variations in manufactured products may arise by altering the texture or degree of fineness of one or more constituents of body, glaze, colour, or enamel.

Some experiments by A. Heath* may be cited to illustrate this point. The contraction and porosity of a fired body may be used as a measure for the progress of vitrification, time being constant. A standard earthenware body was made up with flint graded in different sizes. The average diameter of the flint grains in each experiment is indicated in the following table, with the corresponding contraction and porosity:—

TABLE III.

Average Size Grains.	Flint Variable.		Cornish Stone Variable.	
	Porosity.	Linear Contraction.	Porosity.	Linear Contraction.
Mm.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
0·005	8·3	8·1	0·8	8·5
0·029	12·6	5·8	3 3	8·3
0·042	13·8	5·1	5·5	7·4
0·066	14·2	4·6	6·6	7·5
0·080	14·1	4·8	7·0	7·3
0·100	13·4	4·8	7·8	6·9
0·118	13·7	4·3	7·9	6·9
0·142	12·2	4·2	9·5	6·5
0·239	12·4	4·3	12·0	6·5

A similar set of experiments was made with Cornish stone graded in a similar manner. The porosity determinations are affected by the regular, comparatively large, experimental errors.

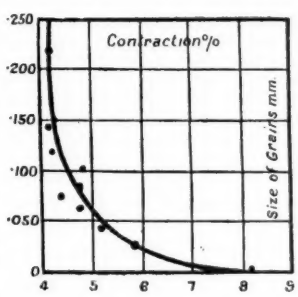

 ·250
·200
·150
·100
·050
0
Contraction %
Size of Grains mm
4 5 6 7 8 9

Fig. 1.

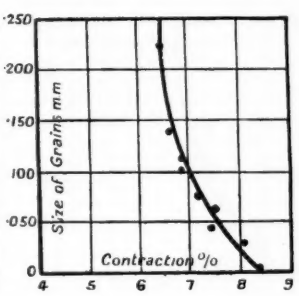

 ·250
·200
·150
·100
·050
0
Size of Grains mm
Contraction %
4 5 6 7 8 9

Fig. 2.

It will be obvious from these numbers, which are plotted in figs. 1 and 2, that the finer the particles the greater the contraction and the less the porosity. In other words, the finer the particles of the reacting constituents the more rapid the progress of vitrification.

The effect of varying the size of the grain is more marked with flint than with stone, because the latter vitrifies at a lower temperature, and does its work more quickly. The effect of varying fineness is more apparent if the firing temperature be reduced.

Making allowance for the influence of temperature, the reaction proceeds proportionately quicker at the beginning, when there is a lot of work to be done, than later, when the work is nearing completion. The finer-grained particles get through their work in the earlier stages of the firing much more quickly than the larger-grained particles. At the higher-firing temperature, the larger-grained particles have more opportunity to make up for their slower speed at the beginning of the reaction.

These principles are further exemplified by similarly varying the size of the flint, Cornish stone, and frit in a standard glaze, and firing all the trials under constant conditions. The surface of the glazes with the coarser grades of flint are rough under conditions where the finer grades produce clear, bright glazes. Similar results are obtained by grading the Cornish stone. The effect produced with the coarse grades of flint and stone resemble, in some respects, the effects produced by short-firing glazes.

The grading of the frit has no appreciable effect on the result with the system of measurements used. A coarse-grained frit, owing to its rapid fusion and comparatively low-firing temperature, is able to get through its work almost as quickly as a fine-grained frit. With a less fusible frit, the effects of coarse grinding would, no doubt, become more marked.

When fire-bricks, saggars, &c., are made with grog and fire-clay, quite different results are obtained by mixing the clay and grog soaked in water or dry grog with water.† In the latter case, when clay and grog are wetted together, fine particles of clay are naturally carried into the pores of the grog; whereas when wet grog is mixed with the clay, the pores of the grog will not be so readily permeated by the fine particles of clay. The differences observed in practice could have been deduced from the principles here laid down. Bricks made from "dry" grog will usually give a brick with a closer texture, less porosity, and one which will vitrify more rapidly in firing than a brick made from wet grog; but certain methods of manufacture may, of course, easily interfere with this effect.

Obviously, if the constituents of a body be imperfectly mixed,

* "Trans. English Ceramic Society," II., 31 (1902), and IV., 42 (1905).

† S. T. Wilson, "Trans. English Ceramic Society," VI., 121 (1907), and H. W. Edwards and A. Leese, *ibid.*, II., 14, (1902).

we shall have the reaction progressing at different rates in different parts of the same body, and the importance of intimate mixing will be sufficiently obvious. Many faults can be traced to imperfect mixing, and that frequently in spite of the seeming care taken to secure perfect mixing.

Slow Vitrification Contrasted with Rapid Vitrification.

The slower the rate of vitrification, within certain limits, the safer and easier the fireman's work. Rapid vitrification means that the range of temperature between "easy-fired" and "hard-fired" ware is comparatively narrow, and that the differences of temperature in different parts of the same oven must be kept small. Slow vitrification generally means that the range of temperature between "easy-fired" and "hard-fired" ware is a comparatively wide one, and greater variations in the temperature of different parts of an oven will not produce such marked effects on the ware. Bodies which vitrify quickly accordingly present greater difficulties in the firing. This is more particularly the case when the vitrification of a body is carried to near the point where the ware begins to lose its shape. The above statements indicate the source of the one difficulty—tendency to deformation—in the firing of some "hard" porcelains which have been compounded with frits and fluxes with a view to reducing their firing temperature. Slow vitrifying fluxes—like Cornish stone—are comparatively safe; rapid vitrifying fluxes, like lime and those said to have been used at Sèvres for making "soft porcelain" are dangerous. These remarks apply to glaze and body, not to the adjustment of glaze to body. This would involve another study altogether.

The smaller the number of experiments, the easier it is to draw generalizations, and the more likely are the generalizations to be erroneous. It is easy and dangerous to lay down general laws. I have noticed the above principles running through so many diverse changes, and I have found them so helpful in the interpretation of many obscure phenomena, that I have attempted to emphasize them particularly. The ideas may, however, be found running through many previous papers. The principles may be masked in special cases. Secondary changes may occur; certain constituents may volatilize; the body may be dissolved at different rates by the glaze, and give rise to crazing or peeling; colouring oxides may be attacked at different rates; crystallization may set in, &c.

The Fusing Test as a Standard of Refractoriness.

A highly refractory clay may "break down" in a furnace before a less refractory clay. Hence, it is urged, "mere softening at an elevated temperature is of little value in determining the real refractoriness of a clay in use." The "fusing test" has been much abused and much misunderstood. This does not invalidate the test as a basis of classification or as a guide in furnace work. We must bear in mind that refractoriness *per se*, and consequently also the "fusing test," is of prime importance. However many other technically important qualities a clay might possess, it is useless as a fire-clay if it squats below the highest temperature attained in a given furnace. We therefore select as the minimum temperature for our "fusing test" resistance to the lowest maximum temperature likely to be attained in an industrial furnace. I place this in the vicinity of 1500°.

The objections to the "fusion test" indicate that in many cases different properties of clays are being confused. The fact that a highly refractory siliceous brick will not stand on the exposed hearth of a Siemens-Martin furnace does not make the silica brick non-refractory. One brick may resist basic fluxes. One brick may be particularly valuable in resisting high temperatures under load conditions; another, the cutting action of flame under forced draught and the slagging effect of ashes; and yet another, the tendency to splitting with fluctuations of temperatures. So we might enumerate quality after quality without impairing the value of the suggested test.

It is utter confusion to imagine that refractoriness *per se* is alone required in practice; and it is utter nonsense to allege that because a clay is refractory *per se* it will therefore resist all fluxes, crushing strains, the abrasive effects of dust and flame, sudden temperature changes, furnace gases, &c. A manufacturer would be more simple than shrewd if he accepted a certificate of refractoriness *per se* as a guarantee that a clay necessarily possesses all the other valuable qualities. At the risk of writing platitudes, I must emphasize the fact that each clay has its own specific character, and each clay must accordingly be judged by its own properties. A clay may be deficient in some qualities, and possess others highly developed. The former—possibly including refractoriness *per se*—may be of no particular importance for the work to be done in a particular furnace. The clay might be a "low-grade fire-clay," but yet prove far more satisfactory than a "high-grade fire-clay" deficient in the qualities necessary for the work in hand. A consumer must therefore clearly recognize what qualities are of vital and what of secondary importance under a given set of conditions; and tests must be devised whereby each quality can be represented by number, and be subjected to measurement. When the consumer has a chart showing the technically important qualities of a number of given clays, it will be a simple matter "to draw up a balance-sheet," and select the clay most suited for the purpose in hand. Unfortunately, methods have not yet been devised for testing all the technically important qualities of clays, though some progress has been made with one of them—viz., refractoriness *per se*.

ESTIMATION OF AMMONIA AND CYANOGEN COMPOUNDS.

By Dr. Knublauch, of Ehrenfeld, Cologne.

The following is an abstract translation of an article by Dr. Knublauch in the "Zeitschrift für angewandte Chemie" of July 25, on the "Estimation of Ammonia and Nitrogen." The methods described are the outcome of the author's large experience in the testing of materials from gas-works and coke-ovens, and differ from those frequently employed in that they are more rapid and require only simple apparatus.

Ammonia Determination.

The apparatus used for the determination of ammonia by distillation is shown in fig. 1. As soon as air has escaped from under the bell, the standard acid rises in the latter, and a little water is then added to seal it. If 25 or 50 c.c. of liquor is taken for distillation, the conical flask should be of about 125 c.c. capacity.

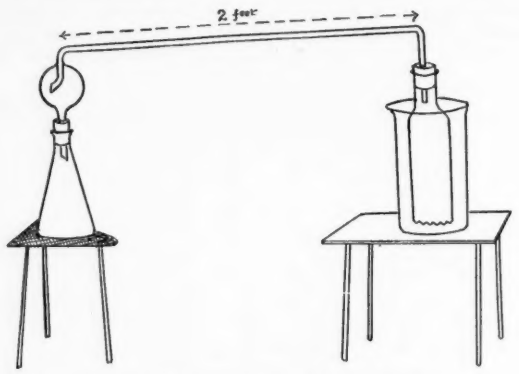


Fig. 1.—Knublauch's Apparatus for the Estimation of Ammonia.

If it is necessary to cool the absorption vessel, in consequence of a large quantity of liquor having been taken for the distillation or of the distillation having been hurried, it is sufficient to stand the vessel in a bowl of water. The author has found that no ammonia escapes absorption, and that all of it is evolved if one-third of the volume of liquor is distilled off. In order to be on the safe side, in practice he distils off about two-fifths of the liquor. Examples are given of the application of the method to seven different ammoniacal products—viz.: (1) Gas liquor, of which 100 c.c. is diluted to 500 c.c. and 25 c.c. taken for distillation with a small lump of caustic soda. (2) Sulphate of ammonia, of which 25 c.c. of a solution containing 1 gramme of the salt is distilled with a lump of about 1 gramme weight of caustic soda. (3) A concentrated gas liquor of which about 5 c.c. is dropped into a stoppered measuring flask of 125 c.c. capacity containing about 25 c.c. of water. The flask is weighed before and after addition of the liquor, and the volume is then made up to 125 c.c., of which 25 c.c. is taken for titration with normal acid. The rest of the diluted liquor is distilled with about 1 gramme of caustic soda. The results of the titration and distillation should be in close agreement. (4) Liquor ammoniæ, which is dealt with in the same way as concentrated gas liquor, except that a larger sample (about 7 c.c). is weighed off in a drawn-out tube with well-fitting stopper and is opened under water and diluted to 250 or 500 c.c. (5) Effluent from sulphate of ammonia plant, of which about 50 c.c. is distilled with lime. (6) Spent oxide, of which from 5 to 10 grammes are taken in a conical beaker of about 200 c.c. capacity, and then distilled with about 120 c.c. of water and 1·5 to 3 grammes of lime. The quantity of ammonia in spent oxide differs very greatly according to the efficiency of the scrubbers. (7) Ammoniacal spring water, of which 500 c.c. is acidified with sulphuric acid, concentrated to 125 c.c., and 50 c.c. of the residue distilled with caustic soda. In the example given, 6·67 parts of ammonia per 100,000 were found.

Nitrogen Determination.

In the determination of nitrogen by Kjeldahl's process, the amount of ammonia isolated is very small compared with the volume of material handled, and hence very large apparatus is required. The author has succeeded in reducing the size by taking 0·7 to 1 gramme of the substance and using only from 7 to 12 c.c. of sulphuric acid, instead of 20 or 30 c.c. as required by Kjeldahl's method. Thus a smaller quantity of soda has to be afterwards added, and quiet distillation is secured with a much smaller volume. The author has also found that 0·25 gramme of mercury suffices in place of 1 gramme; and the precipitate is thus only one-quarter as much. In order to be able to boil the tiny quantity of acid which he uses, the author employs flasks of the shape shown in fig. 2, the narrowed bottom of which contains about 8 c.c. He has these flasks both in glass and in quartz, and they are useful for many other purposes. In a flask of 225 to 250 c.c. capacity, which can therefore be subsequently used for the distillation, about 7 c.c. of sulphuric acid can be kept at the

boil for several hours. The flask is stood on wire gauze shaped to correspond with its bottom.

Fig. 2.—Knublauch's Flask for Nitrogen Determinations.

Many organic compounds are completely decomposed, and the whole of their nitrogen is given off as ammonia without the addition of mercury. With sulphocyanides the addition of mercury is actually harmful, and it may be dispensed with with ferrocyanides. In cases where mercury is necessary, as little as possible should be used—say, 0·1 to 0·15 gramme, and 7 c.c. of concentrated sulphuric acid, with a substance which is fairly easily decomposed. In some cases, cupric oxide may be used in place of mercury, and the alkaline sulphide or the zinc dust dispensed with in the subsequent distillation. With a difficultly decomposable substance, 0·1 to 0·3 gramme of potassium chlorate may be added gradually towards the close. After cooling, the flask is rotated, so as to wet its walls with the acid, and 20 c.c. of water is added to it carefully. Then the liquid is made alkaline by adding a solution of caustic soda (330 grammes to the litre) from a graduated cylinder, with the use of rosolic acid or some other indicator which is sensitive in the warm.

The quantity of liquid necessary for quiet and rapid distillation depends on the nature of the substance, and on whether the mercury-ammonia compound has been decomposed with alkaline sulphide or with zinc dust. With organic compounds, dilution to 50 c.c. is sufficient; with spent oxide, to 60-75 c.c.; and with coal and coke, if alkaline sulphide is used and a small piece of granulated zinc, to 100 c.c., but if zinc dust is used to 50-75 c.c., according to whether the coal contains little or much ash. The alkaline sulphide used is sodium sulphide—the so-called liver of sulphur, of which 0·5 to 0·6 gramme suffices for 0·25 gramme of mercury. With distillation with zinc dust, the correct results (agreeing with those obtained with sodium sulphide) are obtained only if a proportion of free alkali corresponding with the quantity of mercury present is added, and the amount of zinc dust used is only about 0·2 to 0·3 gramme. The proportion of caustic soda solution (330 grammes per litre) to mercury should be: For 1 gramme of mercury, about 6 per cent. by volume of the liquid; for 0·75 gramme, 4 per cent.; and for 0·25 gramme, 2 per cent.

The distillation is carried out in the apparatus shown in fig. 1 except that the flask shown in fig. 2 is substituted for the conical flask. The absorption vessel may advantageously be graduated in 10 c.c. divisions, so as to readily show when two-fifths of the liquid distilled has passed over. The author gives some examples of determinations made in this manner. With sulphocyanides, if mercury is used, it must be allowed to act for some time in the cold; otherwise there is loss of ammonia. Actually good results are obtained without the addition of mercury. Mercuric oxide gives low results. With ferrocyanides, both mercuric oxide and mercury give low results, and the addition of either to the sulphuric acid is unnecessary. It follows that, with spent oxide, addition of mercury is undesirable or unnecessary, so far as the determination of the nitrogen present as sulphocyanide, ferrocyanide or double cyanide, and ammonia is concerned; but the original oxide often contains nitrogenous organic compounds, to decompose which mercury or cupric oxide is desirable.

In order to cope with these conditions, the author takes 1 gramme of the finely pulverized oxide (dried at 50° to 60° C.) and adds it to 7 or 10 c.c. of strong sulphuric acid in a flask of 200 to 250 c.c. capacity, and of the pattern shown in fig. 2. It is left to act in the cold for about 5 minutes, then gently warmed for from 15 to 20 minutes, and finally boiled for 10 minutes. The flame is removed, and 0·25 gramme of mercury or 0·05 gramme of cupric oxide is added, and the boiling resumed. Decomposition is generally completed in 1 to 1¼ hours. After cooling, 20 c.c. of water are added, then caustic soda solution until the reaction is alkaline, and the whole is made up to 60 c.c. or 75 c.c. with water. Either 0·5 or 0·6 gramme sodium sulphide or 0·25 gramme zinc dust and 4 c.c. caustic soda solution (330 grammes per litre) is added, and the liquid is distilled to two-fifths of its volume. If cupric oxide has been used instead of mercury, it is unnecessary to add sodium sulphide or zinc dust. An example is given to show that the alternative procedures mentioned all afford the same result.

In addition to this method of determining the nitrogen in spent oxide by means of sulphuric acid, the author describes the determination by means of soda lime. He has tried this method on potassium ferrocyanide, and found 19·79 per cent. of nitrogen, as compared with a theoretical 19·87 per cent., and on a sulphocyanide, a bog oxide, and ammonium sulphate, and found the results satisfactory. The apparatus used in determinations by this method has already been described in the "JOURNAL" [Vol. CXX., p. 294, fig. 1]. It is shown that the nitrogen contained in all the nitrogenous constituents of spent oxide can be determined with even greater precision by heating to incandescence with soda lime than by any other method.

The author gives the results of comparative determinations of two different samples of spent oxide by the soda lime method, the sulphuric acid and mercury method, and the sulphuric acid and cupric oxide method. The results by the three methods are in very close agreement. The soda lime method has the advantage that a larger quantity of spent oxide may be taken for determinations, which is useful with oxides containing little nitrogen.

With coal and coke, decomposition is less readily effected than with the materials already considered. The determination may be satisfactorily made by taking 0·7 to 1 gramme of the finely powdered coal or coke and decomposing it by means of from 10 to 12 c.c. of sulphuric acid with either 0·25 gramme of mercury or 0·05 gramme of cupric oxide. The cupric oxide requires a longer time. Towards the end of the decomposition it is advantageous to add gradually 0·2 to 0·3 gramme of potassium chlorate. With coal in particular the heating for some time after the start should be very gentle. Later, when it is heated more strongly for ten minutes, the flask should be surrounded by a jacket, and in two or three minutes the condensing vapours will wash any adhering coal down from the walls. Stronger heating for about 2½ hours then takes place; and after addition of 0·2 gramme of potassium chlorate the boiling is continued for a quarter of an hour. The liquid should finally become colourless. A flask of from 225 to 250 c.c. capacity and of the pattern shown in fig. 2 is used. The decomposed material obtained in this way is then distilled with 0·5 to 0·6 gramme of sodium sulphide and a piece of zinc after dilution to 100 c.c., or with zinc dust and caustic soda after dilution to 50 to 70 c.c. in the manner described for the estimation of nitrogen in spent oxide. Examples are given showing fairly concordant results on two samples by the use of sodium sulphide and zinc dust. It is necessary to make blank determinations and allow accordingly for any nitrogen derived from the reagents.

Other examples are given of determinations of the nitrogen in five samples of coal of varying character and ash-content, which show that by the ordinary Kjeldahl method the results are lower than by the author's modification. The difference is not constant. The use of zinc dust in place of sodium sulphide has the advantage that the quantity of liquid to be distilled, even with coal, is only 50 to 60 c.c., and with many other materials much less; so that with the apparatus shown in fig. 1 25 c.c. or less of distillate are obtained. This is very advantageous, as compared with the large volume of liquid in Kjeldahl's process, when the quantity of ammonia is very small.

The author summarizes his conclusions as follows:

(1) Much smaller quantities of sulphuric acid and mercury than are usually employed are sufficient in determinations of nitrogen in organic substances, and with many compounds the addition of mercury is unnecessary or even disadvantageous.

(2) With materials containing sulphocyanides mercury should not be added, and the sulphuric acid should first be allowed to act in the cold. Spent oxide should be dried at 50° to 60° C. before being powdered for the test.

(3) The nitrogen in sulphocyanides, ferrocyanides, and double cyanides is readily converted quantitatively into ammonia by heating to incandescence with soda lime. This method is applicable to the determination of nitrogen in spent oxide.

(4) The flask shown in fig. 2 admits of the use of only 7 to 12 c.c. of acid, and the quantity of liquid to be distilled is thus reduced to 50 to 60 c.c., as compared with eight to ten times as much by the usual process.

(5) When the mercury-ammonia compound is decomposed with zinc dust, a certain amount of free alkali must be present. The amount depends on the total quantity of mercury in the liquid, and not on its percentage.

(6) The alkaline liquid does not always contain all the ammonia in combination. The amount combined depends on the quantity of free alkali.

(7) When the proportion of nitrogen is high, the liquid should be only approximately neutralized with a solution of alkali; and after the apparatus is set up for the distillation, a small piece of caustic soda should be added, and then the sodium sulphide.

(8) If the conditions indicated above are fulfilled, concordant results are obtained with either zinc dust or sodium sulphide. Less dilution is required with zinc dust.

(9) Blank experiments give higher results with zinc dust. It appears that the alkalinity is sufficient to convert nitrogen oxides into ammonia, and that, while reagents may readily be kept free from ammonia, it is not easy to obtain them quite free from nitric acid. When the proportion of nitrogen is small, and the titration is done with dilute acid, care should be taken that the distilled water used is quite neutral both in the test itself and in the blank test. Water distilled from ammonia-free water is always alkaline.

Gas Concessions in Belgium.—According to the Engineering Supplement to "The Times," the Special Commission appointed in Antwerp to consider the proposal submitted by the Imperial Continental Gas Association for an extension of the present concession, to expire in 1927, have decided to reject the proposal, notwithstanding a reduction of 3c. per cubic metre (8d. per 1000 cubic feet) and other advantageous conditions suggested by the Association. The present price is 15c. per cubic metre (3s. 5d. per 1000 cubic feet). The intention of the authorities appears to be to take advantage of the low price at which gas from coke-ovens may now be obtained. In view of the concession for the supply of gas at Verviers expiring in 1916, the authorities have decided to contract for a supply to the town at 3·45c. per cubic metre (9½d. per 1000 cubic feet). This gas will, it is stated, be obtained as a bye-product from coke-ovens.

NEW METHOD OF COOLING GAS-ENGINES.

THIS was the subject of a paper read by Professor BERTRAM HOPKINSON, F.R.S., at the summer conference of the Institution of Mechanical Engineers, held at Cambridge last Tuesday. It may be remembered that, towards the close of his lectures on "Gas-Engine Research" at the Royal Institution early in the year, which were noticed in the "JOURNAL" at the time, Professor Hopkinson dealt with the problem of cooling the engine cylinder, and described, by the aid of a diagram thrown on the screen, a new method he had devised for the purpose. An account of the results obtained by it formed the basis of his Cambridge paper. It was generally acknowledged that the author's work in the direction indicated constitutes an important advance in the operation of internal-combustion engines. The following are the portions of the paper bearing directly upon the subject.

THE PROBLEM OF COOLING.

The most important peculiarity of the gas-engine—that which determines the characteristic features of its design and operation—is the heat-flow from the hot gases into the cylinder walls. About 30 per cent. of the heating value of the fuel passes into the metal of the engine in this way; and it is necessary to provide means for its removal as fast as it goes in. In all engines hitherto made (excepting the small air-cooled engines), the removal of the heat has been effected by the circulation of water round the cylinder, and in large engines in the substance of the piston and exhaust-valve. External water-cooling is the ultimate cause of most of the disadvantages under which the gas-engine has hitherto laboured, and which have retarded its development in large sizes. For many purposes these disadvantages might not in themselves be very serious, having regard to the superior economy, were it not that there are secondary effects of this method of cooling which tend to make a large engine unreliable in working. If it were possible to allow large gas-engines to work continuously at the maximum power they are capable of developing for short periods, the cost per horse-power would be reduced by 20 to 40 per cent. When once these difficulties and their cause have been clearly stated, it seems fairly obvious that they can be overcome by applying the cooling medium on the inside of the cylinder, instead of to the outer surface. If water can be injected internally against the surfaces to be cooled, the heat is removed on the side of the metal on which it is generated, and therefore there is no heat flow through the metal, and no difference of temperature between the inner and outer surfaces.

The idea of introducing water into an internal-combustion engine is not new. It is quite a common practice in oil-engines to put in water along with the oil in order to enable the compression to be raised; and water has been sprayed into gas-engines for the purpose of preventing pre-ignition. Proposals have also been made to introduce water for the purpose of cooling parts of the metal. None of the latter, however, have been practical successes, if indeed they have ever been more than suggestions on paper, apparently because their originators did not appreciate the conditions which must be satisfied if the injected water is to act as an effective cooling agent. Of these, the most important is that the water must be projected in comparatively coarse drops or jets directly against the surfaces to be cooled, so that it reaches these surfaces in the liquid form without much loss by evaporation on the way. Further, it must be properly distributed, so that each portion of the metal receives water in the proportion in which it receives heat. If the water be turned into steam before reaching the metal, it will not exert any cooling effect except indirectly by lowering the temperature of the flame; and such lowered temperature is accompanied by a considerable loss of efficiency. If the water is not properly distributed, those portions of the cylinder walls and piston which do not receive an adequate supply must lose, by conduction to the properly cooled portions, the heat they receive; and, in consequence of the inequalities of temperature so set up, an important advantage of this method of cooling—*i.e.*, substantially uniform temperature—is lost. It is of no use to inject the water in a fine spray produced by an atomizer, or to introduce it into the gas or air pipe, so that it is carried in suspended in the incoming charge or (as is often done in oil-engines) to spray it in along with the oil. Though some of these devices have proved useful for the prevention of pre-ignition and for the softening of the explosion, none of them is effective for the purpose of cooling. For this purpose it is necessary to project the water positively and directly against the metal surfaces, by means of properly arranged nozzles in a rose, or its equivalent, projecting into the combustion chamber.

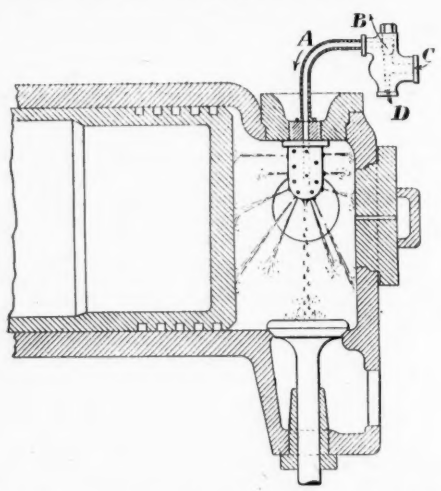
THE NEW METHOD.

The method of internal injection described in the paper embodies this principle. Cold water is injected through a hollow casting projecting into the combustion chamber, and provided with a number of holes or small nozzles about 1-32nd of an inch in diameter. The jets so formed are comparatively coarse, so that even when projected into the flame the water reaches the part of the wall against which it is directed with but little evaporation on the way. The jets are directed to all parts of the surface of the combustion chamber as well as against the face of the piston.

The practical application of this system of cooling has been much facilitated by a discovery made by the author soon after he began experimenting with it. It was well known, from the experiments of Mr. Dugald Clerk, the author, and others, that the rate of heat flow from the gas into the metal is far more rapid at, and soon after, the moment of ignition than at any other time. It seemed likely from these experiments that, for practical purposes, the heat flow into the barrel of the cylinder during the last three-fourths of the expansion stroke might be so small compared with that in the first period that direct cooling of this portion of the cylinder could be dispensed with altogether. This anticipation has been found to be correct. It is sufficient to inject water on to the surface of the combustion chamber and the head of the piston only; the whole of the cooling of the barrel being effected by conduction into the piston, which is itself kept cool by the projection of water on to the head when it is near the in-centre. This, of course, is the opposite of what occurs in a jacketed engine, in which the heat flows from the piston into the jacketed barrel. By taking advantage of this fact, the application of water is confined to places where it can do no harm—none falling on the sliding surfaces. This is a point of some importance if the water contains much dissolved matter. The experimental engine described below has been worked for some thousands of hours, and is now working with a very hard water containing about 0·35 gramme of salts to the litre (25½ grains to the gallon), so that the surface of the combustion chamber and the face of the piston have become thickly encrusted with salts. Yet no trouble whatever has arisen, because no water has been allowed to fall on the sliding surfaces. The absence of pre-ignition under such conditions is also noteworthy, and shows the efficiency of this method of cooling.

TRIALS OF A FIFTY B.H.P. ENGINE.

Description of the Engine and Injection Apparatus.—In order to put these ideas to a practical test, a Crossley engine, 11¼ inches diameter by 21 inches stroke, rated at 40 B.H.P. (with coal gas) at 180 revolutions per minute, was fitted with a new cylinder consisting of a plain barrel without any water-jacket. The valve motions were retained, and the valves and the shape of the combustion chamber were the same; the only change being the removal of all external water cooling. It was therefore possible to make an accurate comparison between the performance of the engine with the new system of cooling, and the results of the measurements of fuel economy and the temperatures of the piston and other parts of the engine which had been made by the author on the same engine when jacketed. The compression ratio in the engine is 6·37; giving a compression pressure of about 175 lbs. per square inch absolute. This is higher than is usual, and proved, when the engine was jacketed, to be too high for ordinary practical working. The successful working of the new cylinder therefore constitutes a satisfactory proof of the freedom from pre-ignition which is characteristic of cooling by water injection.



A. Water to Engine. B. Non-Return Valve. C. Water Supply from Pump. D. To Water Bye-Pass—operated by hand or automatically.

Section of Cylinder with Water-Injection Rose.

A section of the new cylinder with water-injection rose is shown in the following illustration. The rose is a hollow casting, projecting into the combustion chamber. There are in the rose about 25 holes, each 1-40th of an inch in diameter; and the jets proceeding from them are directed, as shown, against all parts of

the combustion chamber and piston-head. There is no jet on to the exhaust-valve, as it has been found that the drip from the rose is sufficient to keep this cool. The water is injected by a simple plunger pump of the same kind as that used for the injection of fuel in Messrs. Hornsby's oil-engines. It is driven by a cam on the valve-shaft, whereby a charge of water is injected once in a cycle. The pump-stroke commences about 30° before and finishes about 30° after the point of ignition; so that water only goes in at a time when practically the whole of the sliding surface of the barrel is covered by the piston.

Fuel Economy and Consumption of Water.—Immediately after erection with the new cylinder, the engine was run continuously for 120 hours on an electrical load with coal gas. Continuous observation was kept of the gas consumption and of the load. The engine developed during this period 43 B.H.P. on the average, and ran very smoothly and steadily. The average mean effective pressure was 101 lbs. per square inch. When it was jacketed, the engine would not develop more than 40 B.H.P. continuously without overheating, and mixtures giving a mean pressure of more than 100 lbs. per square inch produced excessive maximum pressures (over 500 lbs.) with violent thumping explosions. The reduction in maximum pressure, under these circumstances, by water injection is upwards of 100 lbs. per square inch, and the effect is very marked—the explosion becoming almost inaudible. This effect of the presence of steam in the explosive charge is, of course, well known; but the quantity of steam formed in an engine cooled in this manner is so large that it constitutes a substantial advantage of the method.

The quantity of water used on this trial was, on an average, 102 lbs. per hour, equivalent to 2·4 lbs. per B.H.P.-hour. The temperature of the engine varied from 150° to 180° C. No water was visible on the piston or the spindles of the valves; and when the engine was stopped at the end of the trial, the inside of the combustion chamber was found to be perfectly dry. When the engine was jacketed and giving the same power for short periods, the jacket water removed about 67,000 B.Th.U. per hour, which would be sufficient to evaporate 108 lbs. of water at a temperature of 20° C. under atmospheric pressure. The engine consumed in this trial 15 cubic feet of Cambridge coal gas per B.H.P.-hour reckoned at atmospheric temperature and pressure. This is approximately the same as it burnt when developing the same power for short periods when jacketed. Tests at other loads have shown that, with a weak mixture, the gas consumption is slightly increased by the water injection; but with very strong mixtures it is a trifle less. The difference, however, does not exceed 5 per cent. either way; and, on an average, it may be said the economy is unaffected by the use of this method of cooling.

Reliability and Wear under Ordinary Working Conditions.—After the trial just described, the engine was put to drive a dynamo in a factory engine-room. Its speed was then increased from 180 to 195 revolutions per minute. It was left in the hands of the ordinary engine-room staff for several weeks; and was worked continuously for long periods of time at excessive loads. During this time it at times developed 50 B.H.P. with coal gas for several hours together—an increase of 25 per cent. on the maximum continuous load which it could safely carry when jacketed. Since then the engine has been brought to Cambridge, and is now engaged in regular service with a suction gas-producer driving the workshops and producing electric current for the engineering laboratory. It is left to itself like an ordinary gas-engine, giving no trouble at all, and has now been in regular work for two years—the total time of running being 5000 hours. The combined wear on cylinder and piston together in the course of 4000 hours has nowhere exceeded 1·100th of an inch. Over the greater part of the surfaces it is much less.

Trials of Large Engines.—From the nature of this method of cooling it seemed almost certain that its effectiveness would be independent of the size of the engine. Each square foot of metal receives a certain amount of heat from the gas, and it is only necessary to deliver to that square foot as much water as will be evaporated by the heat it receives. The heat received per unit area is greater in a large engine than in a small one; but it did not seem probable that this would materially affect the matter. The truth of this anticipation has been proved by applying the method to the cooling of still larger gas-engines—one an engine of 18½ inches bore, by the National Gas-Engine Company, giving 105 B.H.P.; the other a 1000 H.P. Oechelhaeuser gas-engine, by William Beardmore and Co., of 36 inches bore. In each case, the water was simply run out of the jackets, the injection-rose fitted, and the engine put again to its ordinary work, which was that of supplying electric power to the factory. The trial on the Oechelhaeuser engine is perhaps the more interesting. Three roses were at first used, spaced equally round the combustion chamber, and midway between the pistons. There were 45 jets, each 1·16th of an inch in diameter, arranged to deliver water all over the piston heads and the surface of the combustion chamber. The pump was driven by an eccentric on the side shaft, and was fitted with a valve which confined the delivery of water to the period 45° before and 45° after the in-centre—the rest of the pump stroke being bye-passed. With no water in the jackets or pistons, the temperature of every part of the engine when on full load could be kept within 100° to 200° C.

The engine was taking full load within a few hours of fitting the apparatus, and ran for 30 hours without a stop. After standing for a short time for adjustments, it ran continuously for 70 hours under the same conditions, taking the ordinary factory working load, which would fluctuate about an average of 800 B.H.P. Failure of the water supply, which occurred once or twice in consequence of the temporary nature of the pump gear, did no harm beyond causing some pre-ignitions from the roses and necessitating a reduction of load for a short time. In fact, the engine heats up so slowly and uniformly that there is ample time to deal with such a failure before anything serious happens. The quantity of water used was about 2·4 lbs. per B.H.P.-hour; and it is interesting to note that this amount seems almost independent of the size of the engine. This agrees with the recent developments of gas-engine theory, according to which the heat loss from flame, being largely due to radiation, increases greatly with the depth of the flame, so that the heat-flow per square foot into the metal of a large engine is bigger than in a small engine, though the flame temperature may be the same.

The trials of this large engine, which continued for a considerable time, proved beyond any question that the largest cylinders now built can be cooled entirely by water injection, if applied in accordance with the principles here enunciated. They also showed, however, as might be expected, that for ordinary commercial use the cylinder must be properly designed with a view to the employment of this method of cooling. The experiment of running a 1000-H.P. jacketed cylinder without any water in the jackets was rather in the nature of a *tour de force*, and did not prove to be the best way of developing the idea commercially and in detail. It was, however, an interesting and striking experiment, which showed in a most convincing way the great capacity of the method of internal injection.

The whole injection apparatus was made and put together in Cambridge. It cost about £20, and within a few hours of fitting it on to the engine it was doing all the work of the complicated and costly plant—cooling tower, centrifugal pumps, 8-inch water-mains, and the like—which is necessary for the cooling service of an engine of this size when jacketed.

The difficulties incident to carrying out experiments on an engine which is in regular use for power supply, and cannot be shut down when required for adjustment and alteration, led the author, with Messrs. Beardmore's consent, to abandon for the time the experiments in Glasgow, and to build an entirely new engine designed *ab initio* with a view to the use of water injection, and such as might, with but small modification, be put on the market. The new engine, which is completed and is now undergoing trials, embodies all the experience gained in the experiments described. It is a two-cycle single-acting engine, 18 inches diameter by 24 inches stroke, with separate gas and air pumps, and is cooled entirely by water injection.

DISCUSSION.

The PRESIDENT (Sir H. F. Donaldson, K.C.B.), in proposing a vote of thanks to Professor Hopkinson, expressed the opinion that the proposal put forward in the paper was something more than a suggestion; it was three parts proved. He regarded the new method as an enormous advance, as the elimination of the water space in gas-engines must be a clear advantage. The possibility, also, of being able to run on the maximum load continuously was another. Altogether, the system seemed to hold out some prospect that those firms who were willing to continue these trials on large gas-engines would meet with a good financial return.

Professor W. RIPPER said he considered the trials recorded in the paper the beginning of a quite considerable step in the progress of the large gas-engine. There was, of course, the question as to whether the system would be applied to all sizes. Personally, he took it that where gas-engines were already working satisfactorily in regard to their cooling arrangements, there would not be any probability of Professor Hopkinson's method being adopted, because, though under existing conditions the engine was more complicated, there was nevertheless a debit side. One matter was that, where there was no considerable reason for change, the fact that all the water used in the new system was wasted was an item. The question resolved itself into the capital cost of the present cooling arrangements against the value of the large quantity of water used in the new system. With regard to the quality of the water, it would seem necessary in many cases to have some kind of expenditure upon purifying plant; because otherwise every particle of solid matter in the water would be left behind in the clearance space of the cylinder. It was true also that the presence of sulphur dioxide with the gases, forming sulphurous acid, would tend to cause corrosion. The whole method suggested that a certain amount of skill was required in the working of it.

Engineer Rear-Admiral E. LITTLE said, as far as his own work was concerned, the use of the internal-combustion engine had been hindered by the necessity for so many small cylinders. If Professor Hopkinson's proposal ultimately became a success, there was apparently hardly any limit to the size of the cylinder. He noticed, however, that the author's remarks concerned horizontal engines only, and he would like to know how far it was anticipated that there would be any difficulty in applying the system to the vertical engine. With regard to the quality of water, was it to be understood that any ordinary hard water could be employed, or was it necessary to use distilled water, because the quantity became a considerable item? It was, he believed, something like 24 tons per 1000 H.P.

Mr. W. REAVELL said it would interest him very much to know

whether Professor Hopkinson had tried this method upon the cooling of a vertical gas-engine, and, if so, whether he had found that the solids, which apparently in the horizontal engine could pass away through the exhaust valve, travelled down the cylinder walls, and shaped off the top of the piston head by acting as a grinding material. If they did act in this way, it would be very much to the detriment of the rolling surfaces inside the cylinder. How did Professor Hopkinson propose to deal with this practical difficulty, especially in vertical engines, where the deposits must fall upon the cylinder walls?

Mr. MICHAEL LONGRIDGE pointed out that the idea of putting water into the cylinder of a gas-engine was an old one, and he said he himself had heard of many vague schemes of great economy by combining steam in the gas-engine. Most of them, it seemed, had been more or less failures. Now, however, Professor Hopkinson had brought forward a new one, which was based upon certain scientific facts and laws which had been considered before they had been applied to the building of the gas-engine at all. There had been great improvements in the manufacture of gas-engines; but, speaking from a large experience, he thought he could say that about up to 14 inches diameter the cylinders nowadays were fairly immune from cracking. The moment larger diameters were dealt with, the rate of cracking per engine went up very rapidly indeed; and it was clear that cooling by the internal injection of water would be very valuable. It would also be valuable in small engines, because it would make them cheaper, and possibly slightly more economical in working. The question of trouble from deposit had been mentioned; but there was another trouble upon which he would like to get Professor Hopkinson's opinion, and it was in connection with the rose. Of course, when the engine was standing hot, there was no doubt that a certain amount of deposit would accumulate in the rose; and would this not fill up the small holes which were necessary for the proper distribution of the water? If it did, the consequences would be disastrous. Also, would it not affect the ignition? Would not the sparking-plugs get a deposit of lime on them and become ineffective?

Mr. HENRY DAVEY asked whether Professor Hopkinson had considered the question of a compromise—viz., by jacketing the engine in the ordinary way, but cooling the head of the piston and exhaust-valve by the method described in the paper. He said it seemed to him that the great trouble arose when the cylinders became very large; and the chief trouble was in connection with the piston-head and exhaust-valve.

Mr. ALEXANDER SIEMENS, referring to the objections raised as to the possible accumulation of deposit inside the cylinders, suggested that there could be no objection to cleaning these out from time to time.

Professor B. HOPKINSON said it was perfectly obvious that as the water evaporated any salts must be deposited on the surfaces; but it so happened that the surfaces were very easily got at in this case, and so accumulations could be quickly removed. With regard to the formation of sulphur dioxide mentioned by Professor Ripper, he knew its formation was a source of great danger to any form of gas-engine, and was always possible if liquid water was present in conjunction with gas. But in the method described in the paper there was a margin available of from 100° to 150° C.; so that it was insured that all the water injected on to the cylinder walls and on to the piston head was completely evaporated. Therefore there was not much likelihood of any water in liquid form being present.

Professor H. S. HELE-SHAW, F.R.S., pointed out that most of the speakers had assumed that the same amount of water would be used in this method of cooling as with the ordinary method. He would like to know whether this was really the case, because he was strongly of opinion that it was not so. If the surface was cooled immediately, it would not necessarily follow that the same amount of heat would be generated.

Mr. W. H. PATCHELL said he agreed with Professor Hele-Shaw that the parts in a gas-engine which were cooled by this method could be relatively easily cooled, and that possibly the same amount of water would not be used as in the ordinary case.

Mr. CHARLES HAWKSLEY, referring to the point that all the water would be lost with Professor Hopkinson's method, said it appeared to him that some of it might be collected and, if necessary, purified and used again.

Mr. HOLROYD SMITH said he regarded as rather ambitious the statement in the paper that there would be an economy of 20 to 40 per cent. as the result of so small an alteration in the cooling system. Dealing with the design of the apparatus, he did not think it would distribute the water quite so uniformly as was stated. He concluded by making a suggestion in regard to squirting water into the cylinder. At present this was brought about by the action of a force-pump producing the pressure just when it was wanted; but the speaker thought it would be more satisfactory to have a continuous head of water pressure available, and a bye-pass for producing the intermittent action needed to inject the water.

Mr. J. F. L. CROSLAND, while congratulating the author on the results he had obtained hitherto, expressed regret that the experiments now going on with the Davey-Paxman engine were only upon an 18-inch cylinder. Cylinders of this size were, he said, already working very well; and he would like to see the method applied to one of the larger engines. Perhaps it would be well for the Institution to assist in the making such experiments.

Mr. B. W. BAGSHAW said no one had spoken on the question of the result of the use of the new method from the commercial point of view. In hot climates the gas-engine suffered greatly because a larger size had to be put in than was necessary on account of the extra temperature, and in many places owing to the great altitude at which it was proposed to work the engine. If the invention would achieve what was stated in the paper, it would practically enable a gas-engine manufacturer to offer engines at a price which would help him to compete against steam plant.

Professor B. HOPKINSON, replying to some of the points brought forward in the discussion, said one of the most important questions raised had been the effect of salts in the water, and the character of the water generally; and also whether the invention had been tried on a vertical engine. He had confined himself to the horizontal engine, because in this the salts all got away by the exhaust-valve. With regard to the character of the water, in Cambridge it was very hard; and the engine which had been working for some 5000 or 6000 hours for a period of two years had been using this water. The engine had been very rarely cleaned out. He should imagine the amount of salts deposited during that time must run up to a great many hundredweight, if not tons; but there had been no trouble whatever, either in operating the cylinder or in any other respect. Clean water was absolutely necessary, as without it the holes in the rose would be choked up. It had been said that engines with 14-inch cylinders were sufficiently reliable now, and that there was no particular reason for changing them. He quite agreed that, for the present, the small engine could not very well be touched by his method; but he hoped to invade that field in the future, simply on the ground of reduced cost and greater freedom in design which could be obtained. He did not think he could claim anything for his method in the matter of reliability compared with the ordinary system for small engines. The 14-inch limit, however, was with a four-cycle engine, and with the two-cycle engine it would be much lower. Mr. Crosland had expressed regret that the engine now being experimented with only had an 18-inch cylinder; but he (Professor Hopkinson) reminded him that this was a two-cycle engine, so that it was a larger size than would be the case had the engine been of the four-cycle type. On the other hand, he did not desire that the engine should have been too large, as he wished to experiment with a considerable number of other novel features; also, he had kept the size down as much as possible for reasons of cost. With regard to Mr. Bagshaw's remarks, he could not claim that the new method would reduce the cost of the engine in the way he suggested it might. The difficulty with high altitudes was that it was impossible to get enough mixture into the engine; and he (Professor Hopkinson) did not claim for his method that it would enable more to be put in.

STREET LIGHTING SPECIFICATION FOR AMERICA.

A Committee of the National Electric Light Association of America—consisting of Mr. J. W. Lieb (Chairman) and Messrs. Louis Bell, A. F. Ganz, P. S. Millar, and C. P. Steinmetz—have had under consideration the question of street lighting; and the results of their investigations were embodied in a report which was presented at the meeting of the Association held in Chicago in June.

The Committee commence their report with a few observations on the methods of measuring street illumination: and they remark that there is no single direction which may be counted upon to afford a reliable indication of the light-giving power of all illuminants. Unidirectional rating is inadvisable because it does not afford a satisfactory comparison of illuminants the natural light distribution characteristics of which differ; because it is liable to undue influence in consequence of irregularity of equipment; and because it points the way to manipulation of the light with a view to re-enforcement in that particular direction, irrespective of the illuminating effect elsewhere. The mean of candle-power intensities 20° and 50° respectively below the horizontal has been proposed by Messrs. Abady and Edgcumbe as a basis of measurement; this being taken to afford a fair approximation of the mean lower hemispherical candle power. This is an attempt to rate lamps in terms of mean lower hemispherical candle power by employing street tests to approximate this value.

The Committee consider that one reason why no acceptable solution of the problem of public lighting has been found, is the great uncertainty existing with regard to its fundamental nature. Study of street illumination has not proceeded far enough to enable even the most expert consideration to formulate a correct measure or standard of its effectiveness. Before it becomes practicable to draft street-lighting specifications based upon illuminating effect, extensive investigation of the subject will probably have to be carried out. It remains to be determined where, if any, measure of street illumination may be applied to all systems of street lighting in a way to indicate the relative illuminating effectiveness of each system, and to show systems of different kinds to have equal illuminating value when similar streets lighted by the respective equivalent systems are equally well illuminated. The best means of studying street illumination and arriving at the relative illuminating value of two different installations is not necessarily the best method of specifying the street-lighting service which the contractor undertakes to give and the municipality agrees to purchase.

There are here two separate and distinct problems. In the first—that of deciding among several different systems of lighting

and arriving at the best arrangement of the system selected—the purpose of street lighting must be considered; the fundamental principles of street illumination must be studied; and an effort made to gauge the extent to which these are accomplished. Consideration must be given to such questions as height, spacing, power of lamps, and globes or reflectors. The surroundings and character of the street must be taken into account; and it is important to know the illuminating intensity (maximum, minimum, and average), the uniformity, the amount of glare, the colour of the light, &c. In the second problem—that of providing a means of proving fulfilment of contractual obligations—it is necessary to consider only the simplest and most reliable means of determining if the contractor is giving the stipulated and specified service. It would be desirable, in some respects, to have the same tests serve both purposes; but there is no necessary connection or relation between the two.

Conditions did not permit the Committee to undertake the needed investigations of street illumination preparatory to recommending specifications covering the study of the subject, the comparison of different systems as to effectiveness, and the many other interesting and practical problems which need solution in order to contribute to the best development of the art of street lighting. The more immediate and pressing question of proposing a reliable and simple basis for contracts which shall be definite, free from ambiguity, sufficiently comprehensive to include all types of street illuminants, and flexible enough to facilitate the substitution of newer, superior illuminants when available as alternatives in place of those specified in the contract, was deliberated upon.

Referring in general to those proposals which involve photometry in the street, under actual operating conditions, the Committee consider that they should not be recommended at this time. Conditions for photometry are naturally much less favourable in the street than in a well-equipped testing laboratory. Portable photometric apparatus is usually of a lower precision than high-grade laboratory apparatus. The relative inexpensiveness of portable testing apparatus, which makes it generally available, enables even the inexperinced to make photometric measurements of a character to give general results or approximations. Only the most expert methods, however, can produce accurate results, on which to predicate and decide upon the fulfilment of contractual obligations. Therefore, while emphasizing the importance of portable photometric apparatus, employed under careful restrictions by competent photometrists, for the determination of the illumination produced, and a study of its intensity and distribution with a view to selecting the best system and securing the most favourable location and equipment of illuminants, it has been deemed wise to recommend as a basis for determining upon compliance with contract requirements only laboratory tests, where better assurance can be given of approved apparatus and methods, and of expert photometry. The only exception which should be made to this recommendation is in the case of such illuminants as cannot be removed from the street to a suitable laboratory, and there operated so as to reproduce, with substantial accuracy, the actual service operating conditions.

The Committee recommend the following procedure in drafting street-lighting contracts:—

1.—Describe the lamp which is proposed, including in the description electrical values (volts, amperes, and watts) and total light flux (lumens) or mean spherical candle power, employing well-authenticated conservative values representative of the performance of the lamps under the conditions of service contemplated.

2.—Describe the equipment to be supplied with the lamps, including type of globe, reflector, if any, &c.

3.—Specify reasonable average limits to be allowed above and below the representative values of light flux given in the description, to allow for inherent variables and test inaccuracies which are beyond the control of the contracting company.

4.—Provide for the basis of substitution of other types of illuminants for those specified—either lamps of equivalent illuminating value having other characteristics of lamps of different illuminating values—in order to provide for progress in the art during the term of the contract.

5.—Prescribe the method of testing the circuit while in actual operation to determine the conditions of energy supply as found under actual operating conditions on the system.

6.—Prescribe the procedure for proving fulfilment of contract in respect to illuminating qualities of lamps, including therein the selection for testing in a properly equipped testing laboratory and under the operating conditions as found of a reasonable number of lamps taken from the system, and a test procedure which will assure expert methods, approved apparatus, and a fair evaluation of the lamps.

The Committee submitted descriptive clauses which they considered properly exemplified the principles they had emphasized, and concluded by suggesting that it would be a useful and valuable contribution if a succeeding Committee would undertake to draft a model standard form of contract and specification, which would be clear and definite in their terms, and yet sufficiently flexible to meet the varying conditions to which they would be applied, and which would receive the official endorsement of the Association. It would, they thought, go far towards eliminating the frequent contentions as to the meaning and interpretation of the loose phraseology so common in the current forms of street-lighting contracts.

THE HUMPHREY GAS-PUMPS AT CHINGFORD.

Results of Official Tests.

In the course of a discussion on the drainage system of the Fen district, at the meeting of the Institution of Mechanical Engineers at Cambridge last week, Mr. H. A. Humphrey, in putting forward the claims of his gas-pump on economical grounds as against other forms of pumping, gave the result of the official fuel consumption trials of the large pumps at the Chingford reservoir of the Metropolitan Water Board, a description of which has been given in the "JOURNAL." [See Vol. CXXI., pp. 252, 759.]

The average results obtained for all the five large pumps, working at a rate so that their added capacity was 214 million gallons per day, showed that they only required 0·904 lb. of anthracite gasified in the producers per actual water horse-power-hour. This, Mr. Humphrey said, was easily a world's record in fuel economy under the conditions of quantity and lift. Each pump was tested separately, in the presence of the officials of the Water Board and those of the Pump and Power Company, and the steam for the producers was raised in a boiler large enough to supply the producers for all five pumps. Consequently, the fuel for steam—which, by the way was coke, and not anthracite—was 15 per cent. of the fuel gasified. This figure, under normal conditions, would be about 10 per cent. Adding these fuels together, a total consumption for gas-producers and boilers under normal conditions of 1 lb. of coal was obtained. In other words, the Humphrey pumps were doing about six times the work of the existing Fen pumps for the same weight of fuel. On account of the higher lift of the Chingford pumps, however (about 30 feet), it was not quite fair to make this direct comparison; and, further, some allowance must be made for stand-by losses. These, however, were much smaller with gas-producers than with steam-boilers; and this, again, was to the advantage of the Humphrey pump. If one added a further 10 per cent. for stand-by losses, it made a total fuel consumption of 1·1 lbs. of coal for the Humphrey pump; but this figure could not be guaranteed under the lower lift conditions existing in the Fens. A careful consideration of the conditions led Mr. Humphrey to believe that the coal consumption which could be guaranteed for the average conditions in the Fens when using Humphrey pumps would be 1·6 lbs. per actual water horse-power-hour; and even when using bituminous coal, so as to avoid the expense of anthracite coal, the Humphrey pumps would only consume, at the outside, one-third of the coal now used to do the same work.

In answer to a question in the course of the discussion, Mr. Humphrey made an interesting statement as to the method of measuring the water for the purpose of the tests referred to. The contract for these large pumps, he said, stipulated an official trial, which was to be carried out by three gentlemen nominated by the Water Board; and the figures they obtained were checked by three representatives of the Pump and Power Company. The results were arrived at quite independently; but they agreed so nearly that there was not a solitary question as to the accuracy of the figures. As to the method of measuring the water, there had been a good deal of discussion as to how this should be done. He would have used a Venturi meter; but this would have occasioned a great deal of delay and expense. His own proposal had been to use a submarine weir; but difficulties in the way of employing an ordinary weir were considerable. Eventually, on the suggestion of Mr. Bryan, the Chief Engineer to the Board, a reliable method of measuring the water was obtained in the following manner: They constructed a long geometrical intake basin lined with concrete and stone, and therefore very exact in its section. The water was measured a certain distance down the basin on the intake side. Floats were placed in a line at a given point—two being fastened together by a chain. The floats consisted of ordinary copper ball-cocks—one loaded until it just disappeared under the water, and the other weighted so that it almost touched the bottom. All the ball-cocks were started at the starting-point, and the average time of their floating down to the finishing-point was taken as representing the mean velocity. It was evident that the top ball-cock was trying to go a little faster than the mean velocity, and the bottom one to drag behind; and as they were fastened by a chain, he thought the result gave a very fair average velocity of flow, within quite small limits of error—in fact, he had been told that, if anything, the error would be rather against the pumps than for them.

Preventing the Growth of Sponge in Water-Pipes.—An interesting announcement was recently made at a meeting of the Water Committee of the Cardiff Corporation, when the Water Engineer (Mr. C. H. Priestley, M.Inst.C.E.), stated that he, in conjunction with Professor Parker, had succeeded in overcoming the difficulty experienced with regard to the growth of sponge in the pipes in the filtering area at the Llanishen reservoir. The agent employed was a solution of common salt; and so successful had it proved that up to then there had been no sign of the reappearance of the growth. Mr. Priestley added that Professor Parker himself was so impressed with the result of the experiment that he proposed to write a paper on it for the Geological Society, as a record might prove of assistance to managers of other water-works who encountered similar trouble.

STIMULATING THE GAS-LIGHTING BUSINESS.

In the course of a paper on this subject read by Mr. R. F. PIERCE, of the Welsbach Lighting Company of America, at the last meeting of the New England Association of Gas Engineers, he made the following remarks.

Gas lighting is the very best gas advertisement; and advertising is the life-blood of modern business. If you have 20,000 gas-ranges connected in your town, no one outside the families of the 20,000 users ever sees or hears of them. Their usefulness is largely confined to holding existing business. The influence of gas lighting, however, is not restricted by the four walls which confine the appliance that produces it. The lighting of a building or a street is the one feature which cannot elude the eye. Unconsciously, the shopper mentally appraises the excellence or otherwise of illumination in any store that she may frequent; and the sum-total of her impressions is either favourable or unfavourable. The impression that gas lighting is popular, satisfactory, and up-to-date confers to a great degree the same prestige upon its other uses. Analyze the popular vogue of electricity for lighting, cooking, and ironing the weekly wash. Upon what does it mainly depend? Upon the notion that it is up-to-date, popular, and increasing in popularity. And what can so quickly and so surely create a similar appeal on behalf of gas, as the increasing expansion of gas lighting?

Gas lighting is, and will be for years to come, the backbone of the gas business. From the standpoint of hourly gas consumption of individual appliances, lighting business naturally appears less attractive than some other loads; but upon the basis of revenue per meter per year it will constitute at least half, and generally much more, of the revenue from houses fully piped for gas. There is in some quarters an opinion that gas lighting business is more difficult to obtain than domestic fuel business. This the writer is inclined to seriously doubt. Testimony from the comparative increases in the two fields by individual companies is quite misleading. So much depends upon the relative expenditures of time and energy and advertising. A comparison of the proportion of "dead" services in houses piped for lighting, as against those piped for domestic fuel only, is an accurate indication. There are very few cities in which the proportion of dead services in fully piped houses is not much lower than in houses piped for fuel only. The restriction of gas piping to the kitchen limits the future use of gas to this one room, and absolutely cuts off the gas company from the opportunity of profiting by the development of gas-using appliances designed for use in other rooms.

Perhaps the greatest problem before the gas industry to-day is the securing of adequate piping throughout new buildings. In many cases the percentage of fully piped new buildings is quite satisfactory; in others, very far from it. It is fairly obvious that to a considerable extent the securing of piping throughout will depend upon the popular opinion concerning the advantages of gas lighting; and for this reason, if for no other, gas lighting demands particular attention at this time. In order that the general public may hold a good opinion of gas lighting, it is necessary, first, that gas should be furnished under such conditions that the customer may use it for lighting with a maximum of satisfaction and a minimum of annoyance; next, that the installation should be of such a character as to furnish adequate and comfortable illumination, and reflect credit upon gas lighting from an artistic standpoint; thirdly, that the installation should be maintained in good condition and at high operating efficiency; and, lastly, that the public should be educated into an appreciation of its benefits and advantages.

The first consideration involves the furnishing of clean gas, of uniform quality, at substantially uniform pressure. A gas-lamp is built around a mantle designed to consume a certain fixed quantity of gas of a certain and fixed calorific value. Any deviation from the gas pressure or specific gravity for which the burner is designed and adjusted, or any fouling of the orifice, will disturb the conditions necessary for obtaining the highest efficiency and most satisfactory performance. I cannot emphasize too greatly the fact that the building-up of lighting business must start from the furnishing of gas under good conditions.

The proper design of lighting installations is second only to the continuous satisfactory performance of the appliance. The customer's estimate of gas lighting is based entirely on what he gets out of it. He demands flexibility, originality, and artistic effect; and he will inevitably acquire prejudice against any system of illumination which impresses him as lacking in any or all these requirements. Perhaps we may best approach this subject from a negative standpoint, by calling attention to the supposed shortcomings of gas lighting, and showing how they may be eliminated. They may be enumerated as: (1) Lack of commercially available methods of remote control. (2) Vitiation of the air. (3) Heat. (4) Fixture discoloration. (5) Inartistic appearance.

That remote control is by no means such an essential feature as has been supposed is shown by the rapidly increasing use of pull-chain sockets with electric lamps. For residences, factories, business places, &c., the public are beginning to appreciate that pull-chain control at the lamp (such as has been available for several years with gas-lamps) is the most satisfactory system. The elimination of expensive wiring, and the possibility of controlling individual lamps at the lamps themselves, are the principal features of advantage; and remote control is perhaps more often a disadvantage than an advantage. Where remote control is desired, pneumatic control with pilot ignition is both inexpensive and satisfactory, if properly installed. Magnet valve control is somewhat more expensive, but more flexible and entirely satisfactory. Where infrequent use of lamps makes pilot expense prohibitive (as in churches, &c.), jump-spark ignition is entirely satisfactory, if properly installed and maintained; and the degree of skill required is by means great.

As regards vitiation of the air, there is undoubtedly much public sentiment adverse to gas lighting—based entirely upon fallacious arguments and erroneous premises. Dr. Rideal conducted an impartial and exhaustive investigation on this subject, and found that, under all conditions of ventilation, the air in gas-lighted rooms was equal to that in electrically lighted rooms—showing that gas-lamps, as ordinarily used, were capable, through increasing circulation of air, of removing their own heat and products of combustion. The heat that proves troublesome in gas lighting is the radiant heat: but the heat contained in the uprising products of combustion is absorbed by the ceiling or is carried out by ventilation. The radiant heat per candle power is the same with either gas or electric light. Radiant heat is distributed about a light source in substantially the same manner as the light itself. It is quite natural, therefore, that gas-lamps of high power, giving a high candle power directly downward, should, when hung low, produce a much greater degree of discomfort than electric lamps of lower power hung high. The obvious correction for heat troubles where they exist in gas lighting installations is: (1) Avoid over-illumination. (2) Hang high candle-power units as high as possible. (3) Where the lamps must be low, use low candle-power units only. Perhaps the most frequent cause of heat troubles is the use of units larger than are necessary. It is quite common practice to use an inverted lamp, consuming (say) 4 cubic feet of gas per hour, suspended immediately over a desk. This lamp is substantially the equivalent in illuminating power of a 100-watt tungsten electric lamp. For the same purpose, a 25-watt tungsten lamp at most would be used. It is no wonder that the gas-lamp so employed produces an uncomfortable degree of heat.

Inartistic appearance is by no means a necessary feature of gas lighting, though it has, through neglect, become an exceedingly common one. Within reasonable limits, any artistic effect obtainable in connection with electric lighting may be obtained with equal facility in connection with gas lighting. It does not follow that gas-lamps may be placed in the same positions or locations as electric lamps; but wherever an artistic effect is to be achieved, or an æsthetic purpose realized, it is nearly always possible satisfactorily to utilize gas lighting. Where artistic considerations are of importance, economy is always secondary, usually almost negligible. The advantage possessed by the inverted lamp in the latter direction is by no means sufficient to justify its use under any and all conditions. Residence fixtures are almost invariably such that the equipment of each tip with the smallest-sized upright lamp obtainable is quite sufficient to produce abundant illumination at reasonable expense.

The lines of endeavour which may be profitably pursued in the development of the gas-lighting business depend to a great extent upon local conditions. The gas company is simply a merchant of gas, just as the department store is a merchant of almost everything; and the sale of gas differs in no essential particular from the sale of any other commodity. In fact, it may be said that nine-tenths of the troubles which beset the public service corporation are due to the inability to discern this essential. Wherever you find an aggressive, successful commercial department, you will find a wideawake and competent merchant. This fact is worth emphasizing, since we hear so much nowadays concerning the sale of service, as though it were something quite distinct and different from the sale of a commodity. Surely, we cannot regard the gas company as selling service in the same sense that the architect, consulting engineer, or physician sells service. Do we not really mean that, as a business expedient, to further the sale of gas we give service, exactly as the department store delivers, purchases, and provides other conveniences for its patrons?

Perhaps there is no other factor so important in establishing the prestige of gas lighting as advertising—the real advertising that appeals to the more powerful motives that influence the buyer, as contrasted with the colourless, unconvincing sort of "copy" that confines itself to a mere statement of the economy of gas lighting and the excellence of the company's service. No amount of emphasis upon the economy of gas lighting will instil into the customer's mind a desire for it, unless he is first convinced that on all other grounds it is at least approximately the equal of any other sort of lighting; nor will the excellence of the company's service be very effective in convincing the consumer that gas is the most desirable illuminant. More attention should be paid to exploiting the positive advantages of gas lighting. Advertise the fact that gas is the only illuminant that actually improves the breathing quality of air in interiors, that it produces ventilation and circulation of the air, consumes the brain-stupefying organic matter from the lungs, and incinerates bacteria; show that the only way in which these benefits may be had in connection with other illuminants is by the addition of ventilating fans and ozonizers; and play up every advantage, trivial or otherwise, as if the fate of the business depended upon it. No talking-point is so unimportant that it may not, under some circumstances, turn the balance effecting a sale. Take as an example the colour

value of gaslight. In a very large proportion of stores, true colour value in artificial light is of great importance, and has a value that will be appreciated by the merchant, if properly presented. In this respect, the incandescent gas-lamp is far superior to the tungsten electric lamp. Do we all make the most of this feature? A customer who uses gas because of its economy is always a doubtful asset. He is apt to be lost by the different developments in competitive illuminants that wipe out the cost differential in your favour. On the other hand, the customer who uses gaslight because he believes it to be the best and most desirable illuminant at any price is an asset as dependable as the recurrence of day and night. The cultivation of this sentiment in the public should be the first concern of every gas company. It cannot be done by advertising alone. It must be radiated by every individual in the employ of the company who comes in contact with the public. But before the salesman can inject his customers with the spirit, he must have it himself. What we need is to inoculate ourselves with the idea that anything that may be done with gas is done best when done by gas.

CORROSION OF CAST IRON.

In the course of a paper prepared by Mr. R. H. GAINES, the Chemist to the New York Board of Water Supply, he made the following remarks.

Generally speaking, cast iron resists corrosion better than any other form of iron or steel; the close-grained iron being less acted upon than the more open-grained varieties. Why some cast irons corrode faster than others, when subjected to the same conditions, how the corrosion can be minimized, and the influences which promote this trouble, are all questions of vital interest. Unfortunately, iron is subject to deterioration by oxidizing more than any other metal; and the effects are much aggravated by the fact that the oxide formed lacks the property of adherence, which, in the case of other metals, limits oxidation to a superficial film—the oxide itself forming a protective coating for the interior of the mass. The precise influences which operate, and the changes which occur when iron rusts, have formed the subject of a number of scientific investigations; but it cannot be said that any final agreement has yet been arrived at as to their exact nature, though the electrolytic theory of corrosion is now provisionally accepted by most authorities.

The two essential factors which determine the corrosion of iron in water and in aqueous solutions are the presence of water and of oxygen. No rusting takes place either in air free from moisture or in water free from air. While it has been proved that carbon dioxide is not, as was formerly held, essential to the process, it may be stated that any acidity increases the rapidity with which corrosion takes place; and the presence of alkaline substances, such as lime, inhibit rusting. The latter fact is of the utmost importance in connection with the use of iron and steel in concrete.

Dr. H. M. Howe says that "electrolytic action surely hastens corrosion very greatly, and in practice it may well be true that nearly the whole of corrosion is electrolytic." The writer has always believed that the only corrosion of iron that proves destructive, save that due to stray electric currents, is due to differences of solution pressure at different parts of the metal. The subsidiary constituents of iron and the presence of rust films or even protective coatings, where flaws arise in them, act energetically in promoting decay. When two different substances are separated at one point by a liquid in which one of them is soluble, and are connected at some other point, an electric circuit is formed similar to that produced when the poles of an electric cell are connected. The electric energy is derived from the solution of the material—that is, from chemical action which would otherwise result in the evolution of heat. Such electrolytic action invariably manifests itself when moisture, impregnated with acids from the atmosphere or salts in solution, obtains access to two different constituents of iron, and can even take place between iron and rust, or between iron and paint, if the latter is so far deprived of its oily covering as to become a conductor. It does not follow that the iron in all cases will be the material dissolved by electrolytic action; but in all ordinary cases, except when zinc is the material, it is the iron which suffers solution.

The following laws will apply: (*a*) When iron is in contact with one of the less noble metals (more electro-positive, as zinc) in the series of contact potential differences, and both metals are placed in aqueous solutions producing corrosion, the corrosion of the iron decreases, while that of the other metal is accelerated. (*b*) When iron is in contact with a nobler metal (more electro-negative, as copper) in the same series, under similar conditions, the corrosion of the iron is largely increased. To produce these effects it is unnecessary that there should be sufficient potential difference between the metals placed in the liquid to lead to a visible decomposition of the water, since the effect is observable at even a very low potential difference, though it naturally increases as this rises.

Unprotected cast iron, if long exposed to sea water, undergoes complete disintegration, the iron is dissolved, and a soft, spongy mass of graphite, carbide of iron, and other substances is left. Under the influence of electrolytic action, the electro-negative carbon is left, while the electro-positive iron is dissolved. When exposed to the continuous action of sea water, with more or less complete absence of air—as, for example, at considerable depths below the surface of the sea—it undergoes oxidation to ferrous oxide, becoming extremely soft, though it may retain its original shape. The carbon content of the metal is usually thrown out as a graphite mass, throughout the pores of which the ferrous oxide is lodged. The specific gravity of this material is only about one-sixth of that of the original metal. Experiments have demonstrated that cast iron is more resistant than steel or wrought iron to corrosion in sea water. There is little difference in fresh water.

Blast-furnaces in different localities produce various qualities of pig iron, according to the ore and fuel available; and the chemical composition of the iron from any given furnace may vary within certain ranges according to the contingencies of smelting. These facts must be borne in mind if corrosion is to be minimized by high-quality cast iron. In considering this phase of the subject, it is important to remember that iron is a metal which readily combines with or dissolves nearly all the other elements. It is also unique in the fact that very small quantities fo impurities suffice to entirely change its physical characteristics. The proper control of unavoidable impurities, their homogeneous distribution, and careful furnace treatment, are precautions that will improve the rust-resistant quality of cast iron. If the metal is left with the skin that comes from the mould, it is less easily corroded than when it has been machined. When iron is cast in the sand, some union between the metal and the inside surface of the mould seems to take place, whereby a silicious resisting coating or skin is formed. This skin acts as a preservative coating, much in the same way as steel and iron are protected by the film of oxide produced by the Bower-Barff process. Cast iron protected by the natural coating of slag from the moulds resists oxidation very well. This is no doubt the secret of the greater resistance offered by cast-iron pipes to the destructive action of stray electric currents. The protection afforded by the silicious skin cannot, however, be relied on indefinitely; and after it is worn away cast iron may corrode even more rapidly than wrought iron or steel. With the latter condition the superior thickness of cast iron is the factor favouring its greater durability.

At the present time, it is impossible to say what constituents have the most influence on durability. The relation of the composition to its resistance to corrosion has apparently never been systematically studied; and little seems to be definitely known on the subject. Messrs. Campbell and Glassford, of the Columbia University, conclude that increase in silicon is attended by increased susceptibility to corrosion; and it is the opinion of others that silicon is the most injurious element. In any event, iron of low silicon, phosphorus, and carbon content has resisted corrosion, where irons carrying higher percentages of these elements have failed. The following are analyses of an iron that successfully resisted serious corrosion for years, and another that failed:

	Sound Per Cent.		Failed Per Cent.
Silicon	1·72	..	2·40
Sulphur	0·085	..	0·067
Phosphorus	0·89	..	0·94
Manganese	0·48	..	0 52
Total carbon	2·45	..	3·19
Combined carbon	0·17	..	0·25

Experience has shown that the iron having the greatest density will best withstand the ordinary influences of corrosion. In order to obtain this dense, close-grain iron, the following suggestions are offered: Silicon should be kept as low as is possible, and yet have the castings soft enough to machine; the exact percentage depending upon the thickness of the casting, and the character of the mould. The silicon may range from 0·75 per cent. for heavy work up to 2 per cent. for small castings. Combined carbon is a powerful element in closing the grain and giving a dense iron, and it should be as high as possible, still leaving the iron machineable. Manganese had best be kept moderately high, since it also appears to have some beneficial effect. Sulphur closes the grain, but may give trouble in other directions. As a general proposition, it is better to keep the sulphur low and get necessary density by a proper regulation of silica and manganese. Finally, one of the best ways of closing the grain and securing maximum density is to put steel scrap in the mixture. This is now common practice with makers of hydraulic castings, and is very effective.

Some practical rules laid down by the American Foundrymen's Association for obtaining castings resistant to corrosion are as follows: (1) Use white iron if possible. White irons are especially useful where any acidity is to be encountered. (2) If not practicable to use white iron castings, chill those surfaces which are to be in contact with corrosive conditions. (3) If grey iron must be used, get dense, close-grained castings through the use of steel scrap or otherwise. (4) Avoid oxidized metal. Use pig irons of good quality, together with good cupola practice. If possible, use deoxidizing agents—for example, titanium or vanadium. (5) Keep the sulphur as low as possible.

Gas Companies' Accounts for 1912.—We have received from Messrs. John Allan and Co., the "Gas World Analyses of Gas Companies' Accounts for 1912." The accounts of 53 gas companies are analyzed; all the items of revenue and expenditure being worked out at per 1000 cubic feet of gas sold, and the results set out on two large linen-backed sheets. As in the case of the "Analyses of Municipal Gas Accounts," issued early in the year, cardboard rules are supplied so as to facilitate comparison with figures of any of the undertakings given. The work is priced at 10s. 6d. net.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Feld's Thionate Process.

SIR,—Referring to the editorial comment in the "JOURNAL" for July 15, I would wish to explain some points of my letter of July 8, which seem to have been misunderstood.

As to the extraction of sulphuretted hydrogen. In paragraph 4 of my letter I merely referred to the experiments made in presence of Signor Pacchioni, which gave an extraction of 89 per cent. In paragraph 23 I stated that, although we know that we can extract more than 80 per cent. of the total sulphuretted hydrogen, we only at present guarantee 60 per cent. The calculation given in my letter is, therefore, only based on the 60 per cent. I do not intend to have my present calculation based on results which, although already obtained by experiments on a large scale, and which will assuredly be proved by the plants in course of erection, are not yet proved by a plant in continuous operation.

As to the comparison of the thionate process with the ammonia extraction with water. The figures given in my calculation do not, of course, refer to this process. The ammonia extraction with water and the formation of sulphate of ammonia from ammonia water is, of course, more expensive than the direct sulphatation process.

The net profit per year is not estimated at the maximum capacity all over the twelve months, but only for 250 days—the general cost being estimated at only the maximum capacity for 360 days.

WALTHER FELD.

Linz, July 29, 1913.

The Waltham Abbey Carbonizing Experiences.

In the course of a communication to us, Mr. W. B. Randall says he is anxious for two reasons not to enter into correspondence on the above subject. The first is because in such correspondence side-issues are often raised (as in Mr. Bywater's letter in our last issue) which mask the main point of the matter. In the second place, seeing that he has been elected a member of the Refractory Materials Committee, he does not think the time is opportune to enter into any correspondence in the Technical Press with the Hon. Secretary of the Committee. He proposes, however, to reply to Mr. Bywater's letter at the next meeting of the Committee, and hopes then to be able to clear up the misapprehension under which that gentleman is labouring. Mr. Randall draws attention to the remarks made by him at the meeting of the Institution of Gas Engineers in June, 1912, from the report of which it will be noticed that he stated that a sample of fire-clay material made by manufacturers to the specification of the Refractory Materials Committee, had been sent by him to the National Physical Laboratory for analysis, and their report was to the effect that a distinct softening commenced at temperatures much below the standard specification, and lower than ordinary Stourbridge fire-clay. Yet this new material was offered to his Company at an increased price.

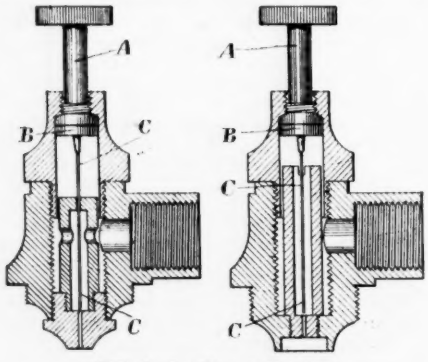
REGISTER OF PATENTS.

Gas-Nozzles.

TILLEY, F. C., of Kingsland Road, N.E.

No. 14,572; June 21, 1912.

This gas-nozzle is combined with a broach or pin for cleaning the nipple, and an interior tube is provided for the passage of the gas.



Tilley's Gas-Burner Nozzles.

Two forms of the arrangement claimed are shown. In the first is a stem A having at one end a collar B (and a washer) to which is fixed a broach or cleaning wire C. To clean the nipple, it is only necessary to unscrew the stem from the nozzle and move it up and down, when the broach or cleaning pin will be passed through the hole in the nipple and clean it; and on a rescrewing of the stem to the nozzle the gas passes readily through the nipple, and the washer will find a gas-tight seating against the end of the hollowed portion of the nozzle.

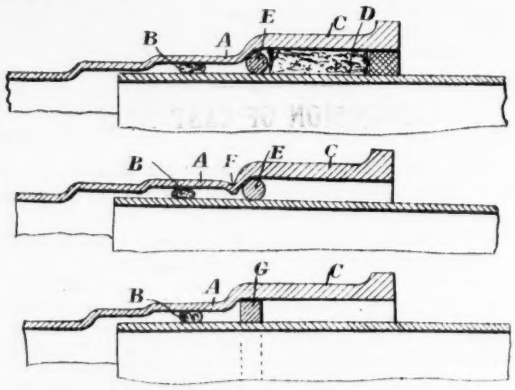
According to the second form, the side holes in the tube are dispensed with; the gas in this case passing up the free space around the tube and entering the latter at the top, which is open for the purpose. In this case, the nipple is dispensed with as a separate piece and the central tube is formed with a solid end having a hole for the outlet of the gas, and formed with a screw-thread for screwing into the contracted end of the nozzle as shown.

Socket-and-Spigot Joints.

SCHOMBURG, L., of Gelsenkirchen, Germany.

No. 14,940; June 26, 1912.

This is a socket-and-spigot joint with a plurality of packings of the kind described in patent No. 24,117 of 1911, in which one packing consists of an india-rubber ring arranged in a narrower part of a multiple-step socket, and another packing (for example, a hemp-gasket and lead packing) is in a wider part of the socket and rests against a step in the socket, or against a ring or the like. The joint is especially advantageous for use with lines of piping—as in mining districts—where the pipes are continually subjected to a bending and longitudinal displacement by reason of movements of the ground, as the end of the spigot or pushed-in pipe is guided on the second shoulder of the socket, and the part of the guide-socket lying behind the shoulder affords room for alterations of length.



Schomburg's Socket-and-Spigot Joints.

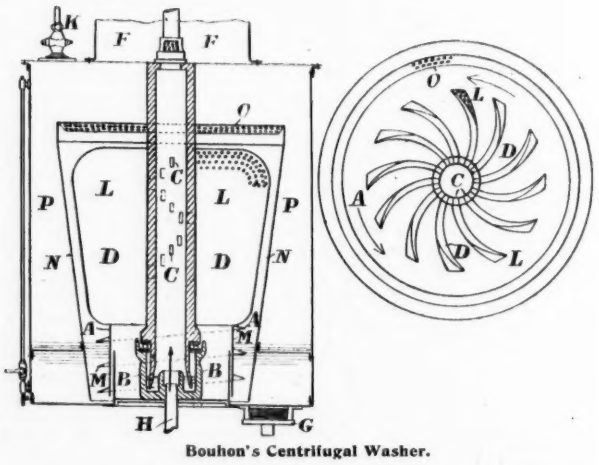
Three forms of the joint are shown in longitudinal central section. In each case, the part A of the socket serves to receive the inner packing B, and another wider part C for the reception of the outer packing D. The india-rubber ring is rolled-in from a position on the outer side of the step, between the parts A and C, during which operation it becomes flattened in cross-section. The outer packing may consist of hemp-gasket and lead, which, in the first two instances, abuts against a rigid ring E lying against the shoulder or step between the parts A and C. In order to prevent forcing out of the india-rubber ring by high internal pressure, and also to obtain a better abutment for the front packing, the front shoulder or step may project inwardly somewhat, as indicated at F in the second arrangement. Also, instead of a loose ring E, a ring G—for example, of rectangular cross-section, rigidly connected to the pushed-in tube or spigot—can be employed as a rigid abutment for the hemp-gasket or the like, as in the third construction.

Purification of Gases.

BOUHON, L. J. R., of Antwerp.

No. 15,209; June 29, 1912. Convention date, June, 30, 1911.

This apparatus (for washing or purifying gases) is of the type in which the gases to be purified are forced under pressure into a rotatable hollow shaft carrying blades or vanes, in the periphery of which shaft are provided perforations through which the gases issue, and in escaping mix intimately with water or other fluid contained in an outer receptacle and set in motion by the rotation of the vanes or other projections on the hollow shaft.



Bouhon's Centrifugal Washer.

The apparatus (as shown) comprises a turbine or rotor A carried by a hollow shaft (provided with longitudinal openings C) on which straight or curved hollow blades are arranged. The rotor works within a fixed cover provided with an outlet F for the gases. An aperture G is provided for cleaning purposes. The rotor is connected with an inlet tube or chimney H through which the gases are forced or drawn. The tank is filled through an opening K to a certain level with water

or "any other liquid suited to the purpose in view." The pipe H is fixed at its extremity to the base B of a stationary member constructed so as to form a receptacle for water. The extremity of the shaft dips into the liquid, so as to prevent any escape of gas from the shaft other than through the apertures C. A ball bearing between a shoulder on the shaft and the upper portion of B allows of a free rotatory motion of the shaft.

The gases under pressure enter the shaft (as shown by the arrow) and pass through the perforations C into the blades D, from which they "pass in a violent manner" through the openings L in one side of the blades—striking "in a forcible manner" the interior surface of the inner drum N. The reaction of the gases produces a circular movement of the rotor in the direction shown by the arrow, the rapidity of which movement increasee as the pressure on the gases becomes greater.

As a result of the centrifugal force of the swirling purifying liquid, and also of the inclination of the fixed walls N and the arrangement of the archimedean screw M, the liquid from below the turbine is driven towards the top of the apparatus. The gases issuing from the blade openings L are then projected with violence against the wall N, which is constantly being covered by the liquid rising from the lower portion of the apparatus. The liquid is continually dashed on to the perforated circular band O; and after leaving it (the centrifugal force of the liquid being overcome by contact therewith), the liquid falls by its own weight into the empty space P between the wall N and the inside of the cover, and is again taken up by the lower worm or screw M to recommence its ascending movement and become loaded with dust, &c., as before.

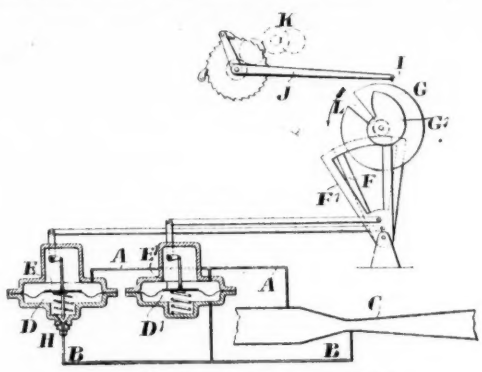
Fluid Meters.

HODGSON, J. L., of High Holborn, W.C.

No. 15,241; June 29, 1912.

The object of this invention is "to provide a practical instrument capable of accurately measuring differences of pressure over a large range, as is required with meters of the Venturi, orifice, or Pitot type, where the pressure difference varies as the square of the flow."

The inventor provides two pressure-measuring devices—such as flexible diaphragms—one being adapted to respond to the smaller differences of pressure, the other to the larger differences; and "in order that the more sensitive device may not be overstrained when the difference of pressure has increased beyond its capacity, means are provided for automatically shutting off the difference of pressure from that device as soon as the less sensitive device has commenced to act." To obtain a counter-record of the flow, each of the diaphragms is caused to operate a flat cam, whose angular motion is proportional to the difference of pressure. Preferably the two cams are mounted on the same shaft and a pivoted feeler is brought down on to them and removed again at regular intervals by means of a clock train.



Hodgson's Difference-of-Pressure Meter.

The accompanying diagram illustrates the invention. Here A and B are pipes conveying the upstream and throat pressures from a Venturi tube C to two chambers D D¹ containing spring-loaded diaphragms E E¹, the movements of which rotate through toothed sectors F F¹ meshing with pinions fast with two cams G G¹. The diaphragm E is much more sensitive than is E¹, which is so arranged as to be practically unaffected by the differences of pressure which actuate the diaphragm E. The chamber D contains a valve H, so arranged that at the pressure at which the diaphragm E¹ begins to act the valve closes the pipe B, and thus prevents any further movement of the diaphragm. I is a feeler carried by an arm J, which is lowered by a clock train at regular intervals, and which actuates a counter K through a pawl and ratchet or similar mechanism.

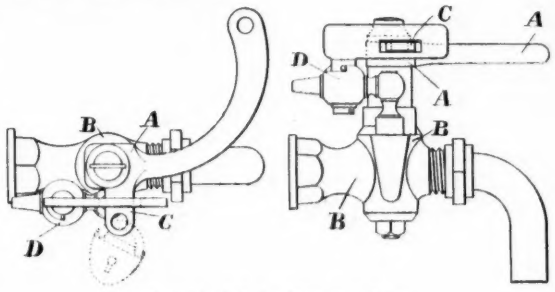
The cams are so shaped that the distance through which the feeler moves between its position of rest and that of contact with one or other of the cams is proportional to the quantity passing. When the flow is small, the movements of the diaphragm actuate the cam G; and the feeler I, coming into contact with the cam, drives the counter. When the flow is sufficiently large, the cam G reaches a position in which a slot L in it lies beneath the feeler, which therefore descends on to the cam G¹, which is now being actuated by the movements of the diaphragm E¹.

Gas-Cocks.

FENLON, H. T., of Tudor Street, Whitefriars, E.C.

No. 15,671; July 4, 1912.

This invention relates to locking taps as described in patent No. 2714 of 1900, in which it is impossible for the gas-tap to be turned on unless the water-tap is open, and it is also impossible for the water-tap to be turned off unless the gas supply is cut off. The present invention relates more especially to means connected with the pilot-light burner tap and the ordinary burner tap, so that when both are turned off it is impossible for the ordinary burner tap to be turned on until after the pilot-burner tap has been turned on.



Fenlon's Self-Locking Gas-Taps.

The illustration is a plan and side elevation of a gas-cock provided with the locking appliances referred to.

The plug or handle A of the ordinary burner tap B is provided with a projecting stem C or pin (either plain or looped or provided with an eye). The handle of the pilot-light tap D has a hole in it; and the pilot-light tap is so positioned with regard to the ordinary tap that when both taps are closed the hole in the pilot tap engages or encircles the stem or pin on the plug or handle of the ordinary tap, so that the latter cannot be opened until after the pilot-light tap has been opened. If the stem or pin is looped or provided with an eye which projects beyond the pilot tap the two can be locked together by an ordinary padlock, as indicated.

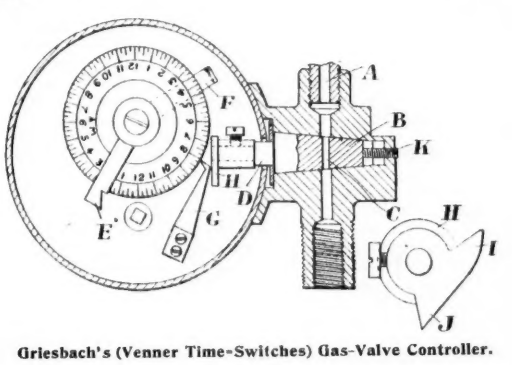
The invention is specially useful for geysers and suchlike water-heaters.

Time-Controlled Valves.

VENNER TIME-SWITCHES, LIMITED, and GRIESBACH, R. C., of Old Queen Street, Westminster.

No. 15,851; July 6, 1912.

This invention relates to valves for controlling the supply of gas, in which the opening and closing of the valve is arranged to be effected by time-controlled mechanism—such as a clock movement. The valve is actuated directly by two adjustable operating arms driven by the clock movement—one arranged to move the valve so as to open the latter, the other being arranged to move the valve in the reverse direction. In order to enable the valve to move quickly towards its open or closed positions by the relatively slow movement of the actuating arms of the clock movement, the leverage exerted by the latter about the axis of the movable valve member is arranged to be comparatively small; and in order that the small leverage thus obtained may operate the valve efficiently, a further improvement consists in constructing the valve member of conical form with an adjustable projection in the valve-seat for ensuring free movement of the valve within the latter, "but at the same time effectually preventing seizure between the valve and its seat, and avoiding leakage of gas between the moving parts of the valve."



Griesbach's (Venner Time-Switches) Gas-Valve Controller.

The mechanism (as illustrated) comprises a casing provided with inlet and outlet passages connected (say) to the gas-burner at A. The interior of the casing is provided with a valve B in the form of a conical plug having a transverse passage C, which, when the valve is in the position shown, establishes communication between the inlet and outlet passages, so as to permit gas to be supplied to the burner. The larger end of the conical valve is provided with a stem or projection D, which extends within a casing containing the time-controlled mechanism. This comprises a clock movement (of any suitable form) provided with a timing dial driven by the main arbor of the clock and two actuating arms E F, which can be adjusted with respect to the dial and clamped to it in any desired position by means of a screw. The timing dial is also adjustable relative to the clock arbor, so that it can be set to correct time as indicated by a pointer G. The stem of the valve B is provided with an actuating member H provided with two projections I J. The actuating arm E, which is adapted to move the valve to its open position, is arranged above the timing dial; the extremity of the arm projecting upwards so as to engage with the projection J on the actuating member—the other actuating arm F (which is adapted to move the valve to its closed position) being located below the dial and adapted to engage with the projection I of the actuating member.

The arm E, being brought into engagement (at the time for which it is set) with the projection J on the actuating member H, the valve B

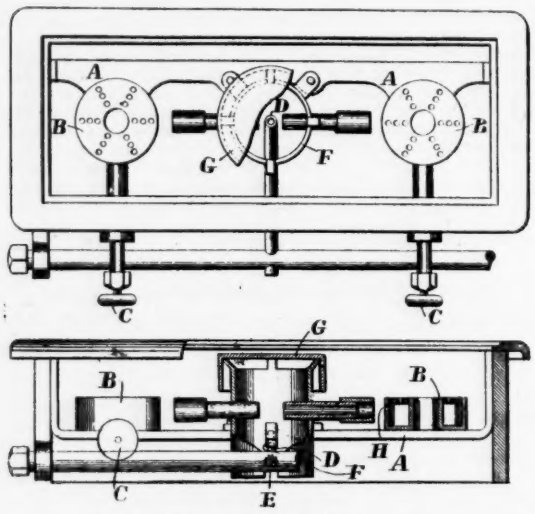
is moved to its open position—thus permitting gas to flow to the burner. When the time arrives at which the other arm F is adjusted to operate, the arm engages with the projection I and moves the valve to its closed position. If for any reason it is desired to supersede the action of the time-controlled mechanism—that is to say, to move the valve to its closed or open position before the time to which the corresponding actuating arms are adjusted—this can be effected by moving the actuating member H by hand without interfering with the subsequent action of the valve mechanism. The screw K is adjusted so as to prevent seizure between the valve and the corresponding valve-seat—thus rendering the valve readily movable under the comparatively small effort exercised by the arms E F.

Lighting Device for Gas-Burners.

SCHAETZEL, G. H., of St. Louis, U.S.A.

No. 16,243; July 11, 1912.

This lighting device is particularly for use in connection with the burners of gas-stoves.



Schaetzel's Lighting Device for Gas-Stoves.

The illustration shows a two-burner gas-stove in top plan view and front elevation (partly in section).

Carried by the frame-work of the stove is a bracket A, on which are supported the burners B, controlled by valves C, as usual. The supply pipe, in addition to serving the burners, also supplies gas to a pipe with an up-turned end D forming a pilot light, provided with a lava top adapted to be adjusted vertically by a friction collar. The supply of gas is regulated by a screw valve E. The pilot light is surrounded by a sleeve F, open both at its lower and upper ends and provided with lugs, which support a removable cap G so as to allow the necessary circulation of air to the pilot light, while at the same time protecting it against draughts. Projecting through the walls of the sleeve are pipes leading to the burners B, each provided at its outer end with a sliding tube so as to adjust the end of the pipe towards and away from the burner. Each burner, in addition to the gas-orifices in its upper face, is provided with a lateral orifice H adapted to discharge into the burner-tubes.

In operation, the pilot light remains constantly burning—its size being regulated by the screw E, and its vertical position by the friction collar below the top. Whenever one of the burners B is supplied with gas by the operation of the valve C, a portion of the gas escapes laterally through the opening H into the burner-tube, and is communicated to the pilot light, where it becomes ignited and conveys the flame back to ignite the burner. The sleeve F, while effectively protecting the pilot light from the influence of draughts and from the effect of water or other liquids dropped on it, at the same time allows the necessary circulation of air to the pilot light.

Pyrophorous Gas Lighting Apparatus.

HALPERN, A., and POSPISCHIL, E., of Vienna.

No. 20,260; Sept. 5, 1912. Convention date, Sept. 7, 1911.

This gas lighting and extinguishing apparatus is of the type in which a friction wheel, under tension, co-operates with a pyrophorous body, and on being released produces sparks which coming in contact with the gas ignites it.

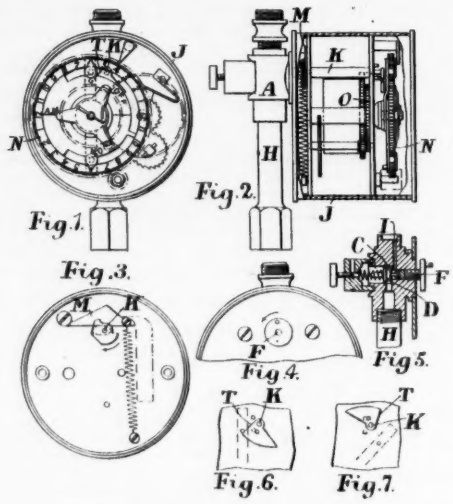
In apparatus of this type it has hitherto been proposed to arrange upon the axle of the friction wheel a spring-tensioned member, and to connect it to the friction-wheel by a one-way clutch; the operation of the apparatus being effected by an actuating lever mounted upon a separate spindle and coupled to the spring-tensioned member by positive driving means. On the other hand, the apparatus described by the present patentee has arranged between the friction-wheel and the actuating member an intermediate disc, which is under spring tension and is adapted to rotate on the same axis as the actuating member—connection with the friction wheel being effected by a "unidirectional driver" and with the actuating member by an "automatically releasable driving coupling or clutch."

Gas Cocks and Valves.

CLEARY, F. G., of Harringay, N.

No. 20,393; Sept. 7, 1912.

When gas-cocks are used for clockwork or pressure controlled apparatus, they often become inoperative owing to deposits of naphthalene and the like collecting on their frictional surfaces, and by stiffening their action cause them to fail in operation. The present invention refers to a gas-cock to operate at small pressure but able to pass a large volume of gas, with means for operating it.



Cleary's Clockwork Controlled Gas-Cock.

Fig. 1 is a front view (with the cover removed). Fig. 2 is a side elevation (partly broken away) with part of the train of wheels removed for clearness. Fig. 3 is a rear view of the back clock plate and mechanism thereon. Fig. 4 is a part front view of the back cover of the clock. Fig. 5 is a vertical section through the gas cock or valve. Figs. 6 and 7 are fragmentary views in the "on" and "off" positions.

The cock A is provided with a horizontal bore, and within its length with a vertical valve seat C; the valve D being kept on its seat by the action of a spring. A portion of the bore is tapped to receive a screwed rod F, which, upon a partial revolution being given to it, forces the valve from off its seat and permits the flow of gas from the supply H to the passage I and thence to the burners—the front end of the screw being hollowed out to receive (with a loose fit) the stem of the valve. A reverse motion being given to the screw F, permits the valve, by reason of its spring, to resume its original position, and cut off the supply of gas to the burners.

In order to operate the screw F at its predetermined times, there is provided in the controller J a spindle K, having at its front end a cam lever, and at its rear end a striker or dog, which is formed with cam faces, both of which are retained in their "on" position (figs. 1, 2, 3, 6) by means of the lever M engaging the cam face of the striker or dog. The arrangement is such that if a partial revolution in the direction of the arrow be imparted to the spindle K, the point of the cam has to lift the lever M out of its path, and passing a predetermined point is forced down on the opposite side by the pressure of the lever and spring, and in so doing allows the valve D to re-seat itself and cut off the gas supply.

The reciprocation of the spindle K is effected in the following manner: On the back of the setting dial N are arranged two arms—the dial and arms being frictionally engaged together and frictionally mounted on a spindle. Each of the arms is provided with a pin—one of which is set at a less distance from the centre of the spindle than is the other one. The spindle is geared by the wheel O to a pinion on a spindle carrying the wheel of the clock train. By this means the clock may be kept within small compass, and the spindle arranged for re-starting the clock by the application of a key.

As shown in figs. 1, 2, 6, one pin is just engaging the face T of the cam lever, and by the continued movement of the dial plate the pin is caused to travel over the face T of the other cam lever and swing it over to the position shown in fig. 7; such swinging motion being assisted by the lever M and its spring.

Gas-Meters.

BERRY, J., and BRADDOCK, G. H., of Oldham.

No. 22,620; Oct. 4, 1912.

This invention, relating to dry gas-meters, has for its object to provide an improved method of securing the leather diaphragms to the parts by which they are supported in their operative positions, "so as to minimize the danger of the leather being overheated during the process of soldering the diaphragm carriers in place within the meter casing."

The patentees claim: (1) The provision (between the metal carrier and the diaphragm) of a protecting layer of a heat non-conducting material completely isolating the carrier and diaphragm; and (2) the combination with the flexible diaphragm and metal rings or carriers disposed at each side of the edge of the diaphragm, of outer and inner layers of heat non-conducting material isolating the diaphragm and carriers.

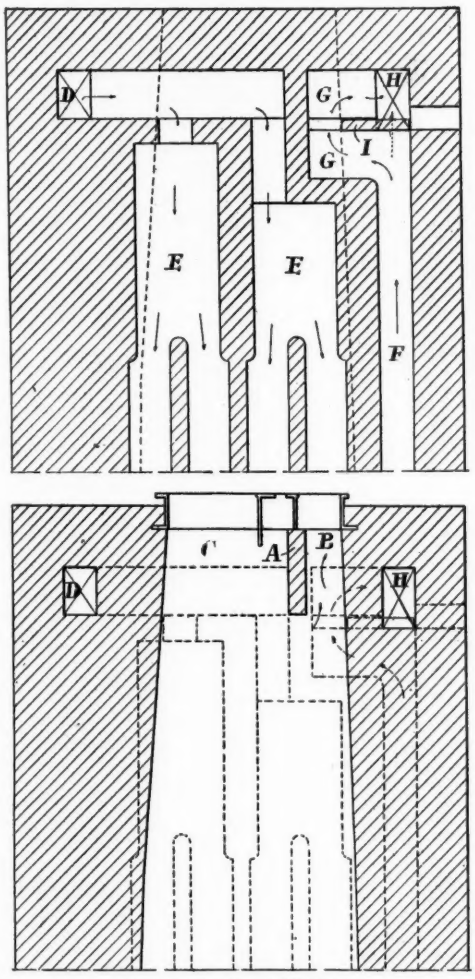
Vertical Retorts for the Continuous Carbonization of Coal.

DUCKHAM, A. M'D., of Ashtead, Surrey.

No. 25,342; Nov. 5, 1912.

In vertical retorts, there has usually been provided (the patentee points out) a division in the upper portion, where the coal enters, "so that the gas evolved, as it leaves the retort, is separated from the incoming coal." This division in the retort forms a free space which is usually heated, so that the liquid hydrocarbons are to a certain extent cracked into gases.

According to his present invention, the patentee provides means by which the temperature of the walls enclosing this free space can be regulated so as to have the requisite heat action on the gases as they leave the retort without affecting the heating of the incoming coal or the remaining portions of the retorts—that is to say, without disturbing the heating of the rest of the retort. For example, the free space may be surrounded (or partly surrounded) by flues which are separate from those which heat the remaining portion of the retort. Such separate flues would be controlled by dampers and be connected with the producer and secondary-air flues, so that they could be heated by direct combustion under due control. Or they might be connected with the waste-gas flues, so that they could be heated by the gases of combustion from flues that heat the main retort—there being a bye-pass flue for adjusting the proportion of the gases which flows around the free space.



Duckham's Vertical Retorts.

This latter arrangement is illustrated in vertical section through the upper part of the retort and a section through the heating flues.

The partition A (which may be adjustable as described in patent No. 28,388 of 1910) separates the free space B from the space C into which the coal is charged. The combustible mixture entering at D descends the flues E, as represented by the arrows; and at the bottom part of the setting [not shown] the products of combustion enter the waste-gas flue F, which is extended partly around the free space B as at G. The products ascend this flue, and having passed through the portion G of it (thereby heating the free space), escape by the flue H. By shifting a sliding damper I, the passage G around the free space is more or less closed; and at the same time a bye-pass for the gases from the flue F to the flue H (indicated by the dotted arrow) is more or less opened. In this way "the temperature of the free space can be suitably varied."

Gas Lighting Torch.

KEITH, J. & G., of Farringdon Avenue, E.C.

No. 24,394; Oct. 25, 1912.

A torch according to this invention includes a cylinder (serving as a carrier for the torch proper and adapted to receive a supply of gas) fitted internally with a freely movable piston for maintaining the gas supply within the cylinder at a uniform pressure and discharging it to the torch proper—the gas being delivered under pressure, or put under pressure by inverting the torch carrier so that the piston acts to draw in a supply of gas which is compressed when the torch-carrier is restored to the upright position.

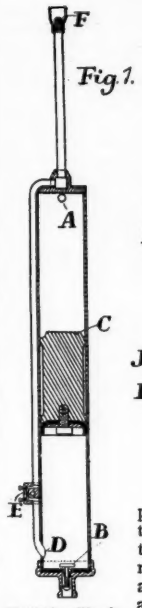


Fig. 1.

Fig. 3.

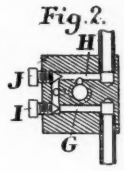


Fig. 2.

Keith's Flash-Light Torch.

The illustration shows a vertical section of the flashing torch, with a vertical and horizontal section of the flash or control valve.

The carrier for the torch proper comprises a cylinder, one end of which (the upper end in the normal upright position of the torch) is open to the atmosphere as at A, while the other end is adapted to be connected to a source from which gas can pass to the cylinder by way of a spring-loaded check valve B, and raise a piston C, freely fitted within the cylinder and provided with a cup-leather packing ring. The action of the piston is to maintain the gas supply within the cylinder at a uniform pressure, and discharge it from a point adjacent the lower end, as at D, by way of a pipe connection provided with a flash or control valve E interposed at any convenient point to the torch proper, comprising a hollow stem uprising from the upper end of the cylinder F and provided at its upper extremity with a jet protected by a sleeve open at its upper end and formed with air inlets near its lower end.

The flash or control valve comprises a casing provided with inlet and outlet passages G H (through which the main bye-pass supply of gas passes on its way to the jet F), controlled by means of screws I J. Ports are led from the inlet passage to one side of a spring-loaded non-return valve, resting normally on a conical seat, and adapted to be moved therefrom, against the action of a spring by means of a manually-controlled spindle or plunger K provided externally with a head or button guided in the valve casing and covered by an outer diaphragm of rubber. The arrangement is such that, on actuation of the spindle or plunger, the non-return valve is moved away from its seat, and a supplemental supply of gas flows past it and thence to the outlet passages H in the control valve casing to the jet F at the upper end of the cylinder. Thereupon the size of the flame normally burning at the jet is momentarily increased—producing a flash light which serves to ignite the burners.

Increasing the Yield of Ammonia from Gases of Dry Distillation.

BURKHEISER, K., of Hamburg.

No. 15,977; July 8, 1912. Convention date, Sept. 26, 1911.

In the course of his specification, the patentee says: Increased attention has recently been devoted to the removal of cyanogen from gases in coal distillation. It has been less the purpose of these endeavours to obtain the value of the cyanogen products recovered than the recognition of the hurtful actions of the cyanogen compounds upon the apparatus. It seems, therefore, that the cyanogen or sulphocyanide products which have been recovered by the purification methods hitherto in use yielded no favourable increase of value, and the cost of works and working were not in proper proportion to the market value of the products.

In order to make the cyanogen purification more economical, means and methods must be sought which make it possible, within the scope or practice of the cyanogen purification process, to convert the cyanogen nitrogen of the gases distilled from the coal into a more valuable product. Efforts with this object produce specially economical results when the cyanogen nitrogen can be converted into a body which is already contained in the gases of the coal distillation and is recovered as a valuable bye-product. The recovery of the bye-products would thereby become simpler and more unified, and would find their expression in the increase of the yield of the one valuable bye-product.

The object of the present invention is to increase the yield of ammonia from the gases of distillation of coal by such means that the cyanogen nitrogen of the gases is first converted by any suitable process into sulphocyanide, then into ammonia, and the ammonia thus obtained is then further worked up with, or led into, the ammonia already contained in the gases.

In patent No. 15,742 of 1912, he points out that there is given a specially simple way of reaching the aim of converting sulphocyanide into ammonia; and, in the process of coal distillation, another known simple way of converting sulphocyanide into ammonia is to deliver the sulphocyanide compounds together with the coal into the distilling retorts, where the conversion of the sulphocyanide into ammonia takes place, so that the content of ammonia in the raw gases is increased beyond their original content by the quantity of this conversion.

The advantages of this process are quite important, especially in respect of the conversion of the sulphocyanide into ammonia, which can be carried out without any special apparatus and means of working in the ordinary practice of the distillation process. Further, the ammonia is mixed immediately with the ammonia produced in the distillation process itself. One is thus able, it is pointed out, to recover the whole of the ammonia collectively by employing one of the known processes for converting it into sulphate of ammonia, ammonia chloride, concentrated ammonia, or into any other desired form. There is also, obviously, the very great advantage that, instead of the cyanogen and

sulphocyanide products which are difficult to dispose of, "the valuable ammonia can be recovered in a convenient form."

It has been proposed to obtain ammonia from the ammonium sulphocyanide extracted by washing from spent oxide of iron which has been used in purifying gas, or from the calcium sulphocyanide resulting from the purification of gas, by the dry distillation of these sulphocyanides with lime or slaked lime; and it has also been proposed to increase the yield of ammonia in the distillation of coal for the production of gas by adding to the coal in the retorts spent ammoniacal liquor containing sulphocyanides. Further, in patent No. 11,517 of 1911—in a process in which the gas is passed over hydrated iron oxide to remove sulphuretted hydrogen and is then freed from ammonia by washing in a liquid which receives sulphurous acid obtained by regenerating in a stream of air the hydrated iron oxide—it has been proposed to return to the gas before it reaches the hydrated iron oxide purifier all the cyanogen, sulphuretted hydrogen, and ammonia which were removed in the preliminary cooling of the gas, as it was found that the cyanogen contained in the gas was retained by the hydrated iron oxide, and was converted into ammonia in the above-described regeneration process—thus increasing the yield of ammonia.

The claim made for the invention is: "The process for increasing the yield of ammonia from gases of distillation, the feature of which is that the cyanogen of the gases is converted into sulphocyanide by any suitable known process and then this sulphocyanide into ammonia by any suitable known process, and the ammonia thus obtained is then further worked up with, or led into, the ammonia already contained in the gases."

Controlling the Period of Artificial Illumination.

GILL, J. H., of Dunedin, New Zealand.

No. 29,928; Dec. 30, 1912.

This invention relates to apparatus "for controlling electric switches or gas-valves," in which an alarum mechanism of an ordinary clock is adapted to control a spring-actuated chain or cord, which, in turn, operates the switch or valve lever. The arrangement comprises (in combination) an ordinary alarum clock; a spring band clip, surrounding the clock, to retain it in position; a supporting bracket, to which is hinged the spring band clip; and a spring actuated chain-pull, adapted to be set by hand and to operate an electric switch or valve lever of a gas-meter when released by the alarum mechanism.

The description of the apparatus given by the patentee, with reference to the drawings which accompany the specification, refers exclusively to plant in combination with an electric light switch.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bill brought from the Commons, read the first time, deemed to have been read a second time, and reported: Airdrie Corporation Gas Order Confirmation Bill.

Bills reported: Barry Urban District Council Bill, London County Council (General Powers) Bill.

Bills read the third time and passed: Derby Corporation Bill, Dunfermline Corporation Water Order Confirmation Bill, Dunfermline District Water Order Confirmation Bill, Heathfield and District Water Bill, Kirkcaldy and Dysart Water Order Confirmation Bill, Liverpool Corporation Bill.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Lords Bills reported: Aberystwyth Corporation Bill, Gas and Water Orders Confirmation (No. 1) Bill [Bagnalstown Order not proceeded with; other Orders confirmed], Metropolitan Water Board Bill, Morley Corporation Bill.

Lords Bills read the third time and passed; Grays and Tilbury Gas Bill, Worthing Gas Bill.

The Airdrie Corporation Gas Order Confirmation Bill was presented on Monday last week, and on Wednesday was read the third time, passed, and sent up to the Lords.

PROGRESS OF SUNDRY PRIVATE BILLS.

Among the measures passed for third reading by various Paliamentary Committees last week were the following.

Aberystwyth Corporation Bill.—This was before the Local Legislation Committee of the House of Commons on Wednesday. The Bill includes powers to construct a new line of conduit from the Corporation's existing reservoir, and also extends the limits of supply.

Barry Corporation Bill.—A House of Lords Committee passed the preamble of this Bill, which deals, *inter alia*, with the laying of water and gas mains upon certain land which the Barry Railway Company contended was private property. The Committee decided to give the powers to lay mains except in roads "used for the purpose of" the Railway Company's dock undertaking.

Morley Corporation Bill.—A Committee of the House of Commons has sent this Bill forward. When the measure was before a House of Lords Committee, there was no opposition to Parts II. and III., which relate to the water and gas undertakings.

IRISH PROVISIONAL ORDERS.

A conference recently called by Mr. Whitley, the Chairman of Ways and Means, led to the striking out of the Provisional Order by which it was sought to confer statutory powers on the Bagnalstown (co. Waterford) Gas Company. The Board of Trade, who had sanctioned the Order, were represented at the conference; and Mr. Anderson attended for the Company. The Bill containing the Order had passed the House of Lords, notwithstanding opposition by the Carlow Rural District Council and other local authorities, who, apart from wishing the matter left over to be dealt with in Ireland, should a Parliament be established there, objected to the Company being empowered to charge 5s. per 1000 feet for gas, which can be obtained in Carlow for 3s. 9d. The Bill had been blocked in the Commons; and Mr. Whitley, realizing that the measure could not be read a second time without discussion, called the conference.

Trouble has arisen over the Electric Lighting Provisional Orders Bill (No. 6), containing Orders in relation to Kingstown and Portrush. The Bill was before a Select Committee of the House of Lords on the 8th ult, in connection with the opposition of the Alliance and Dublin Consumers' Gas Company to the Kingstown Order; but the Committee decided that the Order should proceed [see *ante*, p. 185]. The Bill was passed by the Upper House, and was read a second time in the House of Commons last Tuesday. It was thereupon ordered, on the motion of the Deputy-Chairman, that the Standing Orders should be suspended, and that the Committee on Unopposed Bills should consider the measure next day. This was done, and the Bill was reported, with amendments. These consisted in the omission of the Kingstown Order, the confirmation of the Portrush Order, and the necessary alteration of the title of the Bill. Its consideration as amended was put down for Friday; but it was blocked by Mr. Tim Healy, who gave notice of his intention to move that the Bill should be re-committed to a Select Committee, "in respect of the provisions relating to Kingstown which appeared in the Bill as originally introduced." Mr. Healy will state his reason for this action when the Bill comes up for discussion this week, on a day to be fixed by the Chairman of Ways and Means to suit his convenience. He attributes to the Board of Trade the removal of the Order from the Bill; and unless some satisfactory reason is given to the House for what he characterizes as "the greatest scandal ever committed by a department," he has threatened to block all Private Bills for the rest of the session. Mr. Horner (South Tyrone) will also move that the Bill should be re-committed, and that the Committee be instructed "to re-instate the Kingstown Order and hear all parties, on the ground that the Board of Trade, in withdrawing the Order, have acted in an arbitrary, unconstitutional, and unprecedented manner. According to a communication received from our Dublin correspondent, however, the abandonment of the Order is understood to have been the result of opposition which was being organized among the ratepayers of what is known as "Ireland's Premier Township;" while, in view of political contingencies, some members of the Irish Nationalist Party were hostile to the creation of any fresh vested interests in respect of such undertakings. In the circumstances, the promoters thought it better not to proceed.

NATIONALIZATION OF COAL MINES AND MINERALS.

A Bill, drafted for the Miners' Federation of Great Britain, having for its purpose the nationalization of the coal mines and minerals of the United Kingdom, was issued last Saturday. It consists of a preamble and nineteen clauses. In a "Memorandum" attached to the Bill, its provisions are epitomized as follows.

Clause 1 contains the usual formal provisions for the establishment of a new ministerial office. Clause 2 enables the Minister for Mines to enter into possession on the appointed day without waiting to obtain separate conveyances from all the owners of various interests. By clause 3, the owners of minerals, mineral rights, and mineral wayleaves are precluded from receiving the compensation which is awarded to the proprietors of the coal mine itself. The powers given to the Commissioners under clauses 4 and 5 resemble those which are now possessed by the valuers under the Finance Acts. By clause 6, the purchase price is to be based in the main on the annual output of each colliery, and 10s. or 12s. per ton of such output is named as the maximum price. The average annual output for the years 1906-10 was 261,726,945 tons, so that the maximum purchase price would be about £135,000,000. Under clause 7, payment is to be made in 3 per cent. Government coal stock at par. Clause 8 provides for the Minister of Mines working the mines with his own staff. The power to purchase land compulsorily is also given to him. Clauses 9 to 13 are financial. Under clause 14, the various Acts regulating labour in mines at present in force remain in operation. Clause 15 specifically preserves the right of the State coal mine officials to form trade unions, strike, and generally to join in industrial and political activities. By clause 16, a system of voluntary arbitration concerning industrial disputes in the mines is set up; and clause 17 places on the Minister for Mines the duty of ensuring that there shall be a sufficient supply of coal at reasonable prices throughout the country. The obligations of the railway companies to enable him to carry out his duty are also defined. Clauses 18 and 19 provide the necessary machinery for bringing the measure into operation.

London County Council and Testing High-Pressure Gas-Meters.—It was mentioned in the "JOURNAL" for the 15th ult. (p. 190) that the London County Council would consider, at a special meeting to be held last Tuesday, a recommendation by the Public Control Committee that the necessary measures should be taken for promoting next session legislation relative to the testing of high-pressure gas-meters for use in the County of London. The recommendation in question was adopted by the necessary majority.

LEGAL INTELLIGENCE.

DAMAGE TO ROADS AFTER MAIN-LAYING.

Corporation of Swansea v. Harpur.

About a year ago, the Court of Appeal, composed of Lords Justices Vaughan Williams, Fletcher Moulton, and Buckley, had before them an appeal by the Mayor and Corporation of Swansea from the judgment of the Lord Chief Justice, Mr. Justice Pickford, and Mr. Justice Avory, given at the beginning of the year, and reported in the "JOURNAL" for Jan. 16 (p. 160), confirming the decision of the Justices, under the following circumstances: By section 28 of the Water-Works Clauses Act, 1847, power is given to suppliers of water to open the roads within the limits of their Special Act, and lay pipes, "doing as little damage as can be in the execution of the powers hereby or by the Special Act granted, and making compensation for any damage which may be done in the execution of such powers." By section 85, "with respect to the recovery of damages not specially provided for," the Railways Clauses Consolidation Act, 1845, is incorporated with both the General and Special Acts; and by section 140 of the former Act the amount of the damage, in case of dispute, is to be ascertained and determined by two Justices. The undertakers for the supply of water to the borough of Ystradgynlais, acting under a Special Act incorporating the Lands Clauses Consolidation Act and the Water-Works Clauses Act, broke up the soil of a public road which was within the district of, and was repairable by, the County Council, and laid a water-pipe therein; and the road was then restored to its original condition. The whole of the work was carried out in a proper, efficient, and workmanlike manner, under the superintendence of the Surveyor to the County Council. Eight months after its completion, a portion of the road and the bank supporting it slipped into the adjoining river; and the County Council repaired the damage, which was the result of laying the pipe, at a cost of £87. The Council preferred a complaint before two Justices to recover the cost of repairing the damage; and it was allowed. A case was, however, stated for the Divisional Court, who held that the claim was properly made under section 28 of the Act of 1847, as being a claim for compensation for damage done in the execution of the undertakers' powers; that the compensation claimed was damages, the recovery of which was not specially provided for within the meaning of section 85 of the Act; and that therefore, under section 140 of the Railways Clauses Consolidation Act, two Justices had jurisdiction to ascertain and determine the amount of damages. At the close of the arguments, their Lordships unanimously allowed the appeal. The defendant, who is the Surveyor to the County Council, thereupon took the case to the House of Lords, who last Tuesday dismissed the appeal, with costs.

Liability for Damage through Road Subsidence.

At the Westminster County Court on Monday last week, his Honour Judge Woodfall gave judgment in the case of *Associated Coal Consumers, Limited, v. Metropolitan Water Board.* At the first hearing [*ante*, p. 252], the Gaslight and Coke Company were also cited as defendants; but after hearing Counsel they were discharged. The claim was for £97 for damages to a motor-lorry owned by the plaintiffs; and their case was that on the 20th of November a motor-lorry, while passing over a piece of road in Kensington which had been opened, and was to be opened again by the Water Board to effect some repairs, sank into the ground up to the axle. A pipe owned by the Gas Company was broken; and the escaping gas coming in contact with the fire-box of the lorry caused the flames to shoot up, and the lorry was damaged. It was contended that the Board were not liable, as they had given the Local Authority the statutory notice of their intention to open the road; and that their responsibility ended there. It was also submitted that there was no evidence to show that the leak was in the main; and the Board were not responsible for leaks in service-pipes. His Honour gave judgment for the plaintiffs for the amount claimed, on the grounds that the leak in the road was the original one, and that the Board undertook the repairs of the road, instead of delegating the work to the Kensington Borough Council. He also allowed the Gas Company costs against the Associated Coal Consumers, Limited.

The Law as to Passengers' Luggage.

A case in which the point to be decided was what constitutes passengers' luggage was lately heard by Judge Shand at the Liverpool County Court. The Lancashire and Yorkshire Railway Company sued a Liverpool firm of gas-fitters and sanitary contractors for 7d., the charge for carriage of a "parcel of merchandize" from Liverpool Exchange Station to Waterloo; and it was stated on behalf of the Company that the sole question was whether the parcel, which contained a gas-stove, was ordinary passengers' luggage or merchandize. It appeared that a messenger in the employ of the defendants took a third-class ticket and travelled to Waterloo with a brown paper parcel which contained a gas-stove, the weight of which was 28 lbs. Later an official of the Company asked the firm for payment; and a reply was received expressing surprise at the charge, and stating that parcels of this nature had for years been sent in the same way. It was pointed out that the things a commercial traveller was not allowed to carry in his luggage or samples were enumerated in the Company's regulations, and gas-stoves were included. The Judge: Whether the Railway Company are exercising a short-sighted or a wise policy, I have nothing to do with it; but apparently under the regulations the defendants are bound to pay if the Company demand it. It was urged on behalf of the defendants that if the stove had gone by some other channel the charge would have been only 3d. or 4d., and there would have been no railway ticket to pay for. The Judge replied that he did not see what answer the defendants had got which would help them; and he gave judgment for the Company for 7d., with costs, including 6s. for two witnesses.

MISCELLANEOUS NEWS.

THE GASLIGHT AND COKE COMPANY.

The Half-Yearly Ordinary General Meeting of Proprietors was held at the Chief Offices of the Company, Horseferry Road, Westminster, S.W., on Friday last—Sir CORBET WOODALL, D.Sc., M.Inst.C.E. (the Governor), in the chair.

The SECRETARY (Mr. Henry Rayner) read the notice convening the meeting.

The seal of the Company having been affixed to the Register of Proprietors, the report and accounts were taken as read.

THE GOVERNOR'S SPEECH.

The GOVERNOR: Ladies and Gentlemen, I beg to move that the report and accounts, which have been circulated among the proprietors, be received and adopted.

THE LATE MR. ULICK BURKE.

I cannot proceed with the ordinary business of the day without first referring to the loss which the Company have sustained since we last met. In Mr. Ulick Burke the Company have lost an able, conscientious, and earnest Director, and we, his colleagues, a greatly valued friend. Mr. Burke was my ideal gentleman. He may be said to have carried with him an atmosphere in which nothing mean or disingenuous could live. The value of such men in such situations cannot be over-stated. Latterly his hearing became somewhat defective, so that he had difficulty in following discussions—especially at the Committee of Works, in which he took great interest. Because of this, he on several occasions proposed to me that he should resign his seat. We are glad that he remained with us to the end. He passed away very peacefully, sitting in his chair reading, with little warning and no pain.

THE NEW DIRECTOR.

The Directors have elected to the vacant chair Mr. Henry Woodall, a Member of the Institution of Civil Engineers, who has, since the conclusion of his pupilage some twenty-five years ago, been engaged almost wholly in the construction of gas-works, and in the direction of gas undertakings. I am probably not quite impartial in my judgment; but I am satisfied that it was not open to the Directors to make a better selection.

THE HALF-YEARLY REPORT.

It is now my duty to move that the report and accounts for the half year to Midsummer last be received and adopted. As these have been in your hands for some time, and have no doubt had your careful consideration, I do not propose to occupy time by reading them. Having regard to the circumstances, known to you all, with reference to the price of our raw materials, the Directors are pleased to have so very satisfactory a report to submit.

Our business continues to grow. Over the whole area there has been an increase of 3¼ per cent., compared with slightly under 2 per cent. at the same time last year. If this can be maintained, the prosperity of the Company is assured.

ITEMS IN THE ACCOUNTS.

Some features of the accounts are of peculiar interest; and I will put these before you as shortly as I can. The capital spent has been £48,596; but against this have to be set the amounts brought to the credit of capital for depreciation—chiefly of meters and stoves. These total to £59,922, with the result that the balance of unspent capital is larger by over £11,000 than it was at the opening of the half year. The Redemption Fund, imposed upon the Company by Parliament in 1903, has operated to reduce the amount of ordinary stock by nearly £200,000. In 1903, the total capital raised was equal to £675 per million feet sold; it is now reduced to £550 per million. These figures are evidence of substantial progress; and I hope that each year we shall be able to report further advance on the same lines.

The revenue account shows a credit balance of £648,187. This is sufficient to pay the maximum dividend, as recommended, together with all interest charges, and leave £46,028 to the good. Deducting £15,000, our half-year's contribution to the Redemption Fund, there remains £31,028; and this has been appropriated, as to £20,000 to the Special Purposes Fund, and the remainder (supplemented by a small sum—less than £2000—brought from the net revenue account) to making good the loss sustained through depreciation of investments. The balance carried forward is, as the report tells you, £710,552, compared with £712,387 brought into the account—a reduction of £1835. The accumulated funds of the Company now exceed a million sterling. This is exclusive of the reserve and depreciation funds.

I think you will agree that the Board have acted prudently in writing-down our investments as regards the Special Purposes Fund in Consols to 75 per cent. and India 3 per cent. stock to 80. We have shared the lot of investors generally, and have lost heavily on our various securities. Since 1906 the interest received has been £61,906, and the depreciation £62,453. Had we followed the example of the slothful servant, and buried our talent in the earth, the Company would be better off by £547.

In February last, I remarked that, with a larger increase in sales than the Company had experienced for seventeen years, we had been obliged to draw upon our reserves in order to pay our dividends. This was due to the high price paid for coal. To-day the story is much the same. We have sold 432 million cubic feet more gas than in the same half of 1912, and after making the usual contributions to special funds, our income is just sufficient to provide dividends.

I will give a few details explaining how this comes about. Our gas-rental is more by £59,156; the rents of meters, stoves, and fittings, by £18,656; and residuals are better by £133,066—all most gratifying evidences of growth and prosperity, and totalling to £210,878. Against this, however, comes a coal bill higher by £257,411, which, even when credited with £30,113, the reduced cost incurred in the making of car-

buretted water gas, considerably exceeds the total of our gains. Of the £257,411, a part (£97,175) is due to the larger quantity purchased, and £160,236 to the higher price paid. There has been an increase of £9000 in manufacturing wages, due almost entirely to the replacement of oil gas by coal gas. Repairs and renewals of works have cost more by £16,000, due partly to the speeding-up of our work in preparation for next winter, and also to the largely increased cost of all plant and apparatus, caused in great measure by the high price of coal.

The small reduction in the charges under the heading of distribution is due to the fact that a careful inspection of all the automatic meter supplies in the district, which has been in progress during the past two-and-a-half years, is nearing completion; and the expenditure consequent upon this special inspection has not been so heavy during the half year under review as in those immediately preceding. The expenditure on this work has been profitable, as the putting into thorough order of all the stoves and fittings has resulted in a material increase in the average consumption per meter.

THE FUTURE OF COAL.

I think we have good reason to be satisfied with our record for the half year. It furnishes gratifying evidence of the resources available to the Company in times of special stress. One year of abnormally high-priced coal is over. During it, we have reduced our carry-forward by £58,000; but at the same time we have paid £30,000 to the redemption fund, £40,000 to that for special purposes, and also written-down our investments by over £12,000.

The report states that contracts for the supply of coal extending over the next twelve months have been made at prices materially higher than those paid last year. Our estimate for the year is that these contracts will involve an additional expense of about £175,000; and according to present indications there is not likely to be any considerably increased credit on account of residuals. There is nothing in this outlook, however, to cause us any concern, except that the price of gas must be maintained at its present charge for some little time further. It is impossible to forecast the future with any degree of confidence; but I shall be greatly surprised if the price of coal does not show a reduction by the time the present contracts have expired.

OIL PRICES AND COKE STOCKS.

I ought to explain that the reduction in the quantity of carburetted water gas made is due to the very great increase in the charge for oil—an increase greater even than that we have had to bear upon the coal. We have oil enough contracted for at a comparatively low price to last for nearly a year; and we are husbanding our stocks, in order to make them last as long as possible. One unfortunate effect of reducing the quantity of oil gas made is that the quantity of coke placed on the market is increased, and the price prejudicially affected. An effort is being made by the London and Suburban Gas Companies, acting together, to make more generally known the value of coke for industrial and domestic uses, and so enlarge the home demand.

PENALTY TESTINGS.

One item which occasionally appears in account No. 6—and it is present on this occasion to the extent of £181—is that of "forfeitures for deficiency in illuminating power." Such an item is always a matter of regret to the Directors, who are naturally anxious to comply with statutory requirements as regards the quality of gas supplied. For some years past, the Company have had to live up to a double standard: (1) of illuminating power, and (2) of calorific value. The first, illuminating power, is in these days of incandescent mantles of no moment; it is heat and not light that is required from very nearly the whole of the gas sent out. Further, the test is an unsatisfactory one; considerable differences appearing in the returns made by various observers of the same gas. The question of applying for the adoption of one (the calorific) standard only is engaging the attention of gas companies generally, and of this Company particularly.

NATIONAL GAS EXHIBITION.

The National Gas Exhibition, which is receiving active support from the greater number of the gas undertakings of the kingdom, will be opened on the 1st of October by the Lord Mayor, to whom the members of the Committee are much indebted. This exhibition promises to be not only the most interesting display of appliances employed in the making and use of gas, but also an educational institution of great value. Lectures will be given, and conferences held on various related subjects, and, as a recent report of the Committee says:

> It is confidently anticipated that the holding of these conferences (which will necessarily ensure a considerable amount of Press publicity) will have the effect of bringing home the truth in regard to the hygienic aspect of the utilization of gas for lighting and heating, and of emphasizing the large and varied sphere of usefulness occupied by gas in both domestic and industrial life to a large number of those who are moulders of public opinion.

I cordially commend this effort to the support of all gas shareholders.

FINAL REMARKS.

In conclusion, I am glad to report that the Company's property, works, and plant are maintained in a condition of high efficiency. Our relations with local authorities, consumers, and workmen are of a very friendly character; and the outlook for the future is better than I have known it hitherto. The only blot on the prospect is the abnormal price of coal, which, because abnormal, cannot long continue, and for which, through any probable period, we have made ample provision. I hope and believe that our return to the practice of reduced charges for gas to consumers, with the accompanying increase of dividend to shareholders and of bonus to co-partners, will not be long delayed. I beg to move the resolution. (Applause.)

Mr. JOHN MILES (the Deputy-Governor): I beg to second the resolution.

The GOVERNOR: If there is any point not quite clear to the shareholders, I shall be very glad to hear questions and answer them as far as I can.

REMARKS BY SHAREHOLDERS.

A SHAREHOLDER asked whether the relations of the Company with their employees were satisfactory.

The GOVERNOR: Absolutely so.

Mr. W. A. HOUNSOM thought the first observations which should come from his side of the table ought to be on the same line as that laid down by the Governor, and which was referred to in paragraph 5 of the report. This paragraph was singularly indicative of life here. Little did they anticipate when they met six months ago that Mr. Ulick Burke would so soon pass away; and it was fitting that they should pay their tribute (as the Directors had paid theirs) to one who had so long been connected with this great industry, and who had so faithfully served it. When he (Mr. Hounsom) read the paragraph, he was somewhat staggered at the number of years Mr. Burke had served the Company; and his mind went back to the time of Mr. Beck, and Mr. Phillips, and others, and he confessed that he himself must be getting somewhat ancient. The last two lines of paragraph 5 brought them from the past to the present; and they all recognized and appreciated the way in which an embodiment of long experience and of ripe wisdom and clear judgment had been placed in the deputy chair. With regard to the filling of the vacant place on the Board, he confessed he found some little difficulty in knowing who most to felicitate—the Governor or the Company who required to-day, and would require to-morrow, and the day after, the combination of science and commonsense which was so essential for progress, or the junior member of the Board who came as bearer of a great name and of a splendid tradition. He (the speaker) thought, in short, he could best welcome Mr. Henry Woodall on the part of the proprietors, if he might be permitted to take that bold step, and greet him as his father's son. Turning to the report and the statement of accounts, they had literally to think in millions; and it was necessary to put these millions in commonplace fashion. He looked at the 3½ per cent. increase (which was an increase upon an increase) as indicating that they had sold, instead of 100,000 cubic feet, 103,250 cubic feet; and the customers had paid, instead of a £5 note, £5 3s. 3d. He made this statement because last Monday he happened, after attending a Committee meeting, to be talking to a friend who was a co-proprietor in the Company—a man of more than ordinary capacity, as he was a barrister and capable of looking at things all round—who was a little disturbed about the report and accounts. This gentleman had grown into the habit of looking for an increased dividend automatically; and he was a little bit disappointed at the dividend declared. But, after talking to him about things in general, he was considerably more happy. This led him (Mr. Hounsom) to think that the shareholders were looking at the matter from the payment standpoint and the stockholder's point; and that they ought to do their part towards this great Company. They were all interested in its progress; they all congratulated one another to-day, and the Board, upon the result of the past half year; and yet there was a paragraph which referred to the increase in the price of coal. As a Company they were relatively lowering the price of gas, notwithstanding that the price of coal had gone up. This was a marvellous record, and was one of which they might all be proud; and if at every company meeting in August the public could be made to grasp the fact that because of the rise in the price of coal the price of gas was reduced, it would do a vast amount of good. If the Governor had stated that from the taking of the meters at Christmas there would be a reduction in the price of gas, the fact would have been announced all over London in the Press immediately, though he doubted whether they would be so ready to indicate that by keeping the price of gas at the same figure they were lowering the price relatively to consumers. At any rate, this was the fact. If they could keep down the price, they would strengthen the position all round, as it took a long time for the public to understand the financial position. By and by, in all the households supplied by the Company, there would come—slowly it might be, but surely—the realization of the fact that while the coal merchants' account had gone up, the gas account was still on the same level; and this must tell upon them as a commercial undertaking in the future. It meant that the 3¼ per cent. increase would be further increased. No doubt the trade of the coal merchants was a little bit slackening, and he felt sorry for them; but the fact that there was less coal carbonized in dwelling houses was a cheerful feature from a public point of view. There were other factors which helped to make them cheerful for the future. The way in which gas appliances were being used for heating showed an enormous increase. They wanted science and commonsense to go together, and then they would win. It used to be said that dividends were made in the retort-house; and this was true to-day. But they had come to this, that gas making was a great scientific problem; and the gas maker had not to look so much at how much he was to make per ton, but to see how he could get the maximum quantity of gas and best financial result. And in these particulars he felt sure they would progress, though the Board had to face great difficulties. The Company was a great educational body in regard to the staff they employed.

Mr. ST. JOHN B. ROSCOE inquired whether the coal contracts were made for six or twelve months.

The GOVERNOR: For twelve months. In putting the resolution, I must express, on behalf of the shareholders and the Directors, our cordial thanks to Mr. Hounsom for the wise and encouraging words he has uttered—and not only to-day but on several previous occasions. I am sure if the spirit of Mr. Hounsom could be put into the body of our shareholders, it would redound to the advantage of the Company. I hope he has not at the back of his mind any feeling of disappointment that we have not announced a further reduction in the price of gas. As I said at the conclusion of my speech, we hope to resume that process very shortly; but the reduction of one penny in the price of gas means £137,000 for the year, which is a very heavy amount to provide for. In 1906, objection was taken to the raising of our dividend from £4 8s., as we were living on the hope of better times in the future. But now the dividend is considerably beyond that amount; and we have had no reason to regret the step then taken. I do not think the Board are likely to fail in the matter of courage in dealing with the situation as half years go by.

THE DIVIDEND RESOLUTION.

The motion was put and carried unanimously.

The GOVERNOR then moved the payment of the following dividends: £4 17s. 4d. on the ordinary stock; £4 on the 4 per cent. consolidated preference; and £3 10s. on the 3½ per cent. maximum.

Mr. MILES seconded the motion, which was carried unanimously.

The GOVERNOR: That, Ladies and Gentlemen, concludes the business; and I thank you for your presence.

VOTES OF THANKS.

Mr. WILLIAM KING said they ought not to separate without passing a very cordial vote of thanks to the Governor and the Directors for the able manner in which they had managed the Company's affairs. He was sure they would all wish to associate themselves with the words that dropped from the Governor with regard to the loss they had sustained through the death of Mr. Burke. He had had the privilege of working as a colleague of Mr. Burke at the Board of another Gas Company; and he could thoroughly endorse every word which had fallen from the Governor. The loss of such a kindly, courteous gentleman would be greatly felt by all. But every cloud had a silver lining; and it was pleasant to think that another member of the family of Woodall was now seated at the Board table. He (Mr. King) had been intimately acquainted with the Governor from the time they were boys together; and his son he had known for many years. He felt sure, from his professional bringing-up, that he would prove a very valuable acquisition to the Board.

Mr. W. G. BEAUMONT seconded the motion, which was put and carried unanimously.

The GOVERNOR: On behalf of my colleagues and myself, I thank Mr. King for the very kind way in which he has proposed this resolution, and you, gentlemen, for the hearty manner in which you have received it. I have now the utmost satisfaction in proposing that our best thanks be given to the officers of the Company, and to the workmen acting under their direction. The relations all round are particularly good; and I do not think we could wish to be better served. I may be permitted to refer to a paragraph which appeared in more than one newspaper in the course of the week, speaking of the fact that the profits of the Company have been maintained by very considerable economies effected at Horseferry Road, in the number and payment of the members of the staff. Permit me to say that that is not the direction in which the Company are looking to increase the profits of the undertaking—very far from it. It does so happen there is a reduction of nearly £1000 paid to the officers and clerks; but that is due wholly to comparison with some heavy expenses incurred last year.

Mr. MILES seconded the motion, which passed unanimously.

Mr. D. MILNE WATSON (the General Manager): May I be allowed to express, on behalf of the officers and workmen, our great appreciation of the kind way in which you have referred to us. Our efforts will be made all the lighter by such appreciation from the shareholders.

BRENTFORD GAS COMPANY.

The Half-Yearly Meeting of the Company was held last Friday, at St. Ermin's Hotel, Caxton Street, S.W.—Mr. R. J. NEVILLE NEVILLE, M.P., in the chair.

The SECRETARY (Mr. John T. Croxford) read the notice convening the meeting; and the Directors' report and the accounts were taken as read.

THE LATE CHAIRMAN.

The CHAIRMAN said that, before moving the adoption of the Directors' report and the accounts, he desired to draw the attention of the proprietors to the great loss the Company had sustained by the lamented death of their dear and respected Chairman, Mr. Ulick J. Burke. Mr. Burke was an expert in gas administrative matters—not only in this Company, but in two other companies, and, in fact, he might be said to have spent the best part of his working life in association with gas undertakings. In this Company, he was a *persona grata*. He was a delightful character to have to deal with. He was a man whose gentleness, courtesy, grace, and presence endeared him to every person with whom he came in contact. He was the best type of Etonian and Oxford man, a scholar, and a gentleman. He was a shrewd man of business, with great experience, and had also the manner and power to make those who were under him do their utmost for the various objects with which he was connected. If Mr. Burke never did anything else for the Brentford Company, he did one of the greatest services in selecting for them their Engineer and Manager (Mr. Alex. A. Johnston), under whose able management, in conjunction with their late Chairman, the Board were now presenting these accounts—accounts as favourable as any with which the proprietors, certainly within his own recollection (and he had been a Director now twenty years), had ever been presented. He felt sure the proprietors would like to express their sympathy to those who had suffered personally the bereavement caused by the tragically sudden death of Mr. Burke. To those he loved, his death was a most painful shock, and one which would not be effaced by years.

ADJUSTING CAPITAL VALUES.

Turning to the accounts, he thought the proprietors would agree with him that they were unexceptionally favourable. In the capital account, it would be seen that they had charged a good sum for depreciation, amounting to £13,892, upon stoves, meters, and fixed plant; and there was a new item which had never appeared before, £35,000, "amount written off for estimated value of shops and cottages purchased with land from time to time, and subsequently demolished." The Directors had been buying for a large number of years small plots of land at Brentford when they came into the market. Some of these plots had shops or public houses upon them, the latter with licences attached, and there was accommodation value in the case of strips of land intersecting the proporty as paths or passage-ways, and for all of which the Company had to pay a price. In the books, the land stood at the price they paid for it, including the buildings, licences, and accommodation value. Therefore they had had the plots carefully valued; and, with the consent of the Government Auditor, they had written-off £35,000. They had taken this sum out of the net revenue account; and the undivided balance was smaller by the amount. By doing this, the Directors thought they were putting their house in the best possible order. But for this sum, they would have overdrawn the capital account by £53,000. As it was, they had overdrawn it by £18,630. It was owing to this that the Board were asking the proprietors to authorize the raising of fresh capital.

INCREASE IN BUSINESS—NATIONAL INSURANCE ACT.

Regarding the revenue account, it would be seen that there had been practically a general increase on both sides of the account; but luckily for the Company, these were chiefly on the receipts side. They had an increase in income from gas and meter and stove rental of £10,900, as compared with the June half of 1912; and from residuals of £9137—making a total of £20,037. On the other side of the account, they had a certain amount of increase which naturally arose when they were doing (as they were doing) a very extended business. It would be found that coal and oil cost about £10,131 more; and the wear and tear was £6535 more—making a total increase of expenditure under these two heads of £16,666. But when the economies in other expenditure had been taken into account, the net increase in the expenditure was £16,422. Coal, oil, and wear and tear were therefore practically responsible for the whole of the increase. The wear and tear had been really expended in the modernizing of the plant, and making it thoroughly efficient for the purpose of revenue production. On the same side of the account, an item "National Insurance Act" appeared for the first time. During the half year they had paid £470 under this head; and yet their men did not find those "rare and refreshing fruits," which some of them had perhaps been led to expect. But there would have been a good many cases of difficulty with regard to medical attendance and sick pay, if it had not been for the fact that the Company possessed a Workmen's Provident Club, the solvency of which was guaranteed by the Company. By the rearrangement of the benefits which were given by the club, they were in this position, that the workmen now had the 10s. a week under the National Act supplemented to the extent of 5s. per week; so that they were in the same position as before the passing of the Act. He believed their men felt they had been well looked after by the Directors; and he thought the proprietors would agree this was a proper policy to adopt with regard to their men—to make them, as far as they could, happy and contented. However, the net result of the working of the half year (taking the two sides of the revenue account together) was that they had secured an advantage of £5615; and this had been obtained in spite of the reduction of the price of gas by 1d. since Lady Day. This cost them in revenue about £3250 for the three months—a penny reduction representing about £13,000 a year. Therefore but for this reduction, they stead of the £5615. As one indication of how the business had would have had an additional advantage in the half year of £8800, increased, he might mention that the average amount received per day for gas in the June half year of 1912 was £1043; last half year the average per day was £1091. Rental of meters averaged per day £146 in the first half of 1912; in the past half year, £162. Residuals averaged per day in the June half of 1912, £279; in the past half year, £329. The increases amounted to an average of £114 per day throughout the half year. The net profit for the half year was £59,913; and the dividends which were to be recommended would amount to £46,000, so that they had made in the half year, in spite of the reduction in the price of gas, in spite of the extra cost of coal and oil, a surplus of £13,913, and this was about equivalent to 1d. reduction in the price of gas for a year. The proprietors, he was sure, would feel that they had been well served by all in the Company who had enabled such a return to be made at such a time.

THE CURRENT HALF YEAR.

In regard to coal, under their favourable contracts, they had had coal practically at the old prices for two months; at current prices, they would have had to pay a further £4500. Another thing they had to consider was that, throughout the current half year, they would feel the full effect of the 1d. reduction in the price of gas. This would mean £3000 to £4000. Then, it was unfortunate, rates were rising. It was the quinquennial re-assessment; and the Company had had their assessment raised by about £4000. The Board had been looking into the matter very carefully; and they had done their best to keep the rates down. But they would have to pay a further £1000 in rates; so that, taking these various items together, next half year they could not expect to get a surplus over dividend of £13,900. All they could expect would be about £9000 if the business went on in the same way that it was now doing. It had been the policy of the Board to reduce the price of gas as frequently as possible during the last twenty years; but they had to take such circumstances as there were before them into consideration before authorizing any further reduction.

COAL, OIL, AND COKE MARKETS.

During the half year, there had been 12,000 tons more coal carbonized, which showed the favourable extension of the business. The proprietors would be glad to see that, notwithstanding this, the stocks of coal had increased. Last year there was the coal strike. But this half year they had had delivery of 42,000 tons more coal than they had at the end of June, 1912; and the stocks were in consequence 29,000 tons up. This relieved the Board of the nightmare of coal shortage; and this was a matter for congratulation. There was the future of coal. The Company were in an advantageous position owing to their favourable contracts. The prices of coal and oil were only 9d. more to the Company than they were in the corresponding half of 1912; while the general rise in the price of coal alone per ton was three to four times as much as 9d. During the half year, they had had two months at last year's price of 14s. 9d.; and then they had had favourable oil contracts which had reduced the rise in the price of "fuel" for gas making to 9d. Coal at the present time was at 14s. 6d. per ton f.o.b.; freights cost them 3s. 6d.; and barging cost an average of about 1s. 11d. So that coal would actually cost the Company (say) 20s. a ton. But working in with oil, their price for coal and oil together would not reach anything like this figure. The Company were covered by their coal contracts until December, 1914; and the Board hoped that by that time, the price would materially decrease. Most gas undertakings had experienced a stiff rise in the price of oil—the rise in some cases having been nearly 100 per cent. But their own contracts for oil covered them until August, 1914; and the Directors hoped that the price of oil would drop in that period. There was no doubt, however, that oil was a

commodity for which gas companies would have to pay more heavily than they had done before; as new uses for oil were now coming along every day. The market price was now somewhere about 4d. per gallon. The Company were, under their contracts, paying much less than this; but he was afraid they would never again get back to the old figure. As to coke, in their own case, it had been at a good price. But the high price of oil had made many companies careful of its use; and this meant an increasing production of coke, and a reduced use in manufacture. They, with other companies, were seeing what they could do to maintain the price of coke, as they did not want a break in the market.

INTEREST IN MISCELLANEOUS ITEMS.

The works had been rapidly increasing in efficiency; and at the present time they were in excellent order. Mr. Johnston was a splendid engineer, and always kept his eyes open for all sorts of economy. For instance, he had been using a considerable portion of breeze for making concrete blocks; and new offices and show-rooms had been built out of the material, to the Company's profit. They were cramped for room at their Brentford station; and it would astonish the proprietors to see how every foot of land had been utilized to the fullest advantage by the reorganization of the plant. Luckily, however, they had Southall for extensions; but, owing to the canal dues they had to pay upon every ton of coal there, the initial costs at Southall were always higher than at Brentford. They did not therefore look upon extensions at Southall with such a light heart as they would do at Brentford. The business was rapidly increasing; and the capital now stood at £4 9s. 2d. per ton, against £4 14s. 7d. last year; and at 7s. 1d. per 1000 cubic feet of gas sold, against 7s. 6d. This was good evidence of how the consumption was increasing. The maximum hour's consumption was in January of this year, and the next largest hour's consumption was on a Sunday in July, which showed the effect of cooking the Sunday dinner; and the latter consumption was only 30,000 cubic feet less than the maximum hour of January. They had been making a comparison of the number of gas consumers with the number of houses in their area; and they found they were supplying practically 90 per cent. of the householders in the 49 square miles of the Company's territory. They could not hope to increase this percentage; but there was still an immense field for gas in domestic heating by means of gas-fires, for heating water-circulators, and such-like appliances. They had started in the district a model house, fitted with all kinds of gas appliances; and this was proving very popular.

CAPITAL.

The Board were going to ask the proprietors for authority to raise further capital. The capital account had already been overdrawn to the extent of £18,000. The Directors were last authorized in 1898 to raise £187,000 ordinary capital, and they had also raised £46,000 debentures; so that they had raised £233,000 in fifteen years. They did not, however, propose to issue any capital at the moment; but the time had arrived when they ought to be in the position to raise more money when and as the extension of the business required it.

THE NEW DIRECTOR.

There was one other matter. To the vacancy on the Board they had elected their valued friend, Mr. William Mann. He was a most useful colleague, with his career of 45 years' service in the Company. The Directors thought there was so much of value in this experience that it ought to find a seat on the Board. It had therefore given the Directors great pleasure to elect Mr. Mann to the Board, and to have the benefit of his ripe experience.

Mr. R. SHAFTO ADAIR seconded the motion.

Mr. H. D. ELLIS remarked, with reference to the tragic occurrence upon which the Chairman had dwelt in the opening of his speech, that no words of his could possibly add to the force and pathos of the feeling terms in which the Chairman had alluded to the great loss the Board and the Company had sustained. As an old worker in the ranks of the industry, he should like to act as the voice of the proprietors, and to say how individually, having been accustomed to listen to Mr. Burke in that room, and collectively, as proprietors indebted to him for the guidance and direction of the concern, they deeply felt the loss of such a man as he was. He was a perfect, courteous, English gentleman. Mr. Ellis proceeded to give a few figures from an analysis of the accounts that he had made; and, among his remarks, he said that he made out that 1d. reduction on the price of gas represented £13,900, which was rather more than the £13,000 mentioned by the Chairman. The reduction referred to a year; but these were the surplus profits of a half year.

The motion was unanimously carried.

Proposed by the CHAIRMAN, and seconded by Mr. ADAIR, a dividend was declared at the rate of 5 per cent. per annum on the 5 per cent. preference stock, at the rate of 14 per cent. on the consolidated stock, and at the rate of 11 per cent. on the new (1881) stock.

Also moved by the CHAIRMAN, and seconded by Mr. ADAIR, the Directors were authorized to raise, as required, a further sum of £100,000 new stock.

The CHAIRMAN next moved that the salary of their new Secretary (Mr. John T. Croxford) be £800 per annum. He remarked that the older proprietors must be gratified to see the (to them) familiar household word "Croxford" again appear at the foot of the notice calling the meeting. It was an extremely honoured name in their Company. They all remembered Mr. Mann's predecessor, "dear old Mr. Croxford," who was as kindly a soul as ever drew breath.

Mr. RICHMOND seconded the motion; and it was heartily agreed to.

Extraordinary Meeting.

An Extraordinary Meeting was then held, at which the Directors were authorized, on the motion of the CHAIRMAN, seconded by Mr. ADAIR, to raise further capital by the issue of £25,000 of 4 per cent. perpetual debenture stock.

Proposed by Mr. ELLIS, a very hearty vote of thanks was passed to the Chairman and Directors.

The CHAIRMAN, in responding, made handsome acknowledgment of the able support the Board received from Mr. Johnston, Mr. Croxford, and every member of the staff.

SOUTH SUBURBAN GAS COMPANY.

Half-Yearly Report and Accounts.

The following is the report of the Directors of this Company for the half year ended the 30th of June, which will be presented at the ordinary general meeting on Friday next.

The net revenue account shows that, including the balance brought forward from last half year, and after providing for interest and other charges, the amount available for dividends is £48,145 17s. 2d., out of which the Directors recommend payment of the full statutory dividends, as under: On the 5 per cent. preference stock, 5 per cent. per annum; do., ordinary stock, 6 per cent. per annum; do. West Kent stock, 5⅛ per cent. per annum—carrying forward to next half year £14,574 10s. 2d.

A saving in working expenses has been effected by transferring the manufacture from Bromley and Erith to Lower Sydenham, where the carbonizing results continue to be excellent; the yield of gas per ton of coal carbonized having reached the high average for the half year of 13,060 cubic feet.

Compared with the corresponding half of last year, the sales of gas show an increase of 4·35 per cent.; and the period has been one of exceptional activity in the addition of 2860 new consumers, and the fixing of 3802 cookers, fires, and other gas-heating appliances.

Unfortunately, a further and substantial increase in price has had to be paid for the current year's supply of coal; while at the same time the demand for coke and sulphate of ammonia has fallen off. These circumstances cannot but adversely affect future profits.

The workmen's accident fund, which since its establishment in 1901 has twice been certified as a contracting-out scheme under the Acts of Parliament relating thereto, has again been certified as such by the Chief Registrar of Friendly Societies for a further period of five years; the rules having been revised by the Co-Partnership Committee to meet present conditions. This fund, which applies as from the 1st of July last to all workmen now in the employment of the Company, operates to the advantage of the employees by enlisting the co-operation of all concerned for the prevention of accidents, and securing to the sufferers from accidents greater benefits than they would receive under the Workmen's Compensation Act, 1906.

The number of co-partners has been increased by the amalgamations from 512 to 814; and this year's bonus, amounting to £5607, is at the rate of 7½ per cent. This is an increase of ½ per cent. on last year's bonus, consequent upon the reduction of 1d. made in the price of gas, and is the highest yet paid by the Company under the co-partnership scheme, the excellent effect of which continues to be most marked.

The accounts accompanying the report show that the total capital expenditure at the close of the half year (including the nominal amount added by conversion) was £1,372,815, or £12,843 less than the receipts, viz., £1,385,658, inclusive of the premium capital. A sum of £11,599 was expended on capital account in the half year. The revenue from the sale of gas was £127,504; the rental of meters and stoves produced £11,568; the rental of fittings, £4402; the sale of residuals, £54,066; and the total receipts were £197,727. The following were the principal items of expenditure: Gas manufacture, £97,105; distribution, £37,532; management, £7495; rents, rates, and taxes (£8736), and miscellaneous items bringing up the total to £157,304. Among these items is £2787 charged on account of the co-partnership scheme. The balance carried to the net revenue account is £40,423; and the amount applicable for dividend is £48,145.

The statements as to working show that, under the supervision of Mr. S. Y. Shoubridge, the Engineer, 86,060 tons of coal were carbonized in the half year. The quantity of gas made was 1,093,998,000 cubic feet—all coal gas—of which 1,033,520,000 cubic feet were sold and 1,046,277,000 cubic feet were accounted for. The residuals were; Coke, 1,118,780 cwt.; breeze, 26,017 yards; and tar, 808,364 gallons—the make of sulphate of ammonia being 969 tons.

LITTLEBOROUGH GAS COMPANY.

The Ordinary Half-Yearly Meeting of this Company was held last Thursday—Mr. JOHN C. HUDSON (the Chairman) presiding.

Before introducing the ordinary business of the meeting, the Chairman expressed regret, on behalf of the Directors and shareholders, at the death of their late Chairman, Mr. Alfred Law, J.P., who had been a Director of the Company since its formation in 1865, and had acted in the capacity of Chairman since 1876. He desired to place on record their appreciation of the invaluable services rendered by their late colleague during this lengthy period.

The balance-sheet and report for the half year ended the 30th of June last were submitted and passed. The gas sales realized £4809, against £4480 in the corresponding period of last year; and 36¼ million cubic feet of gas were sold, compared with 33⅓ millions in 1912. There were 73½ million cubic feet of gas sold during the twelve months ended June 30, which represents an increase of 8 per cent. on last year, and is considerably in excess of any previous record; and residual products realized £1749. The profit on the revenue account was £1577, and the disposable balance £3908.

The report of the Manager and Secretary (Mr. S. E. Halliwell) shows that the total sales have increased 50 per cent. during the last eight years, despite the fact that there is not much development in the district, and that high-pressure lighting has considerably reduced the consumption of the larger industrial concerns. The summer consumption has more than doubled in this period; while the demand for prepayment meters has contributed to the increased consumption. The average price received for gas has been reduced from 3s. in 1907 to 2s. 7·8d. this year; while the relation of capital to the business shows considerable improvement, having been reduced to 9s. 9¾d. per 1000 cubic feet of gas sold, or £5 1s. 10d. per ton of coal carbonized. The sales of gas per ton of coal have been increased to 10,500 cubic

feet; while the quantity of unaccounted-for gas had been reduced to 4¼ per cent.

The Chairman, in moving the adoption of the report, expressed pleasure in announcing further progress in the Company's business. He said the sales again constituted a record in all departments, and had compensated for the reductions in price, which had evidently stimulated the consumption. It was gratifying to notice an increased demand for gas for lighting, in spite of competition; and the fact that the quantity consumed for cooking, heating, and trade purposes had more than doubled during the last few years was ample proof of its popularity for use in the home and the works. With their present non-lighting prices, ranging from 1s. 7d. to 2s. 3d. per 1000 cubic feet, they confidently expected further increases in this branch of the business. The position of the Company, both financially and also in regard to the works and plant, was very satisfactory.

The report was adopted, and the maximum dividend of 10 per cent. per annum (less income-tax) was declared. Thanks were accorded to the Directors, Manager and Secretary, and the staff.

SYDNEY GAS STRIKERS PUNISHED.

A Hundred Men Fined.

It was briefly announced in the "JOURNAL" for the 1st ult. (p. 67), that Mr. Justice Heydon, the Judge of the New South Wales Court of Industrial Arbitration, had dealt with a hundred summonses taken out by the Minister for Labour against employees of the Australian Gaslight Company who had participated in the strike early in the year, and brought about the serious condition of affairs described in our columns on the 29th of April. One man was fined £10, and the rest £8 each, with £1 1s. costs in all cases. The fines were paid by the Union. About 2000 men were involved in the stoppage of work; but the Minister for Labour thought that if the Court found there had been a strike, and inflicted a penalty on the men summoned, it might be sufficient vindication of the law. This point, however, he asked time to consider. The subject is so important that we give the judgment practically in full.

His Honour said that in the cases before him it was admitted that there had been a concerted cessation of work by the defendants and a number of other employees of the Australian Gaslight Company; and the cessation was for the purpose of securing certain objects. But it was contended that the objects were such that the cessation was not a strike under the Act. It was further contended that, if the cessation was not a strike, it had been condoned; and if the right to take proceedings before the Court had not actually been given up, at least the penalty should be light.

As to the first point, it appeared that in September, 1911, the Gas Company and the Gas Employees' Union entered into an industrial agreement, which fully settled wages and conditions in the service, and which was to endure for three years. Some twelve months afterwards, the Union claimed an additional 1s. a day all round, and took steps to have the question of wages re-opened. They began a ballot on the question whether or not they should strike; but on application to the Court by the Minister for Labour, an injunction was granted forbidding the counting of the votes. The restlessness continued, and, after some time, an application was made to the Court for a Wages Board. This was refused, on the ground that there was an industrial agreement in force, and industrial agreements could only be varied by the consent of the parties. The day after this decision, the cessation of work began. It was claimed that it took place in consequence of the decision, and was therefore a demand for a Board to determine wages, not a demand for wages. His Honour proceeded as follows:

"It is clear that the Board was only wanted as a step towards higher wages. The men were dissatisfied with the wages in the agreement, and with the provision which bound them to those wages during the term of the agreement. They wanted the obstacle created by their own arrangement swept away. The employers could do this by consenting to vary the agreement, either by reopening the wages rates or by varying them, or by altering the provision as to its duration. The cessation, therefore, was to compel the Company to give some such consent as should remove the obstacle. They struck against their own industrial agreement, and would not work under its conditions. "That, to my mind, is clearly a strike. If not, the strike provisions of the Act could be nullified. The contention, if sound, would enable employees, the moment an award unsatisfactory to themselves was made, to request the Board to reconsider the whole question of wages. If the Board refused, they could at once stop work, and point out that it was not a strike, but merely a cessation of work to set a tribunal in action. The thing is absurd. Industrial agreements are not less binding than awards, but rather more so, for they embody the actual consent of both parties, and can only be cancelled or varied by a similar consent; and a strike against the terms of an industrial agreement is just as much within the Act as a strike against an award.

"The second point—that the right to prosecute had been given up—is equally untenable. No doubt while the strike was on, the employers agreed to take the strikers back, and to victimize none of them, and the Government to call a special session of Parliament to amend the Act and empower a Board to deal with the matter. But these things do not touch the strike. It may at first sight seem peculiar to see negotiations carried on with men who are breaking the law as to the terms on which they will cease to break the law. But this relates to the men's future action, not to their past; and there is not a single word in the agreement to suggest that the strike was to be condoned. Grant that the Company had given up its right to sue for damages for the breach of the industrial agreement, they could not touch the right to prosecute either for the breach of the agreement or for the strike. If an employer, by settling a case with an employee, can take away the right to prosecute, he could escape from the Act by employing non-unionists at low wages, and, if threatened with prosecution, could settle the case with them. I must, therefore, find the cases proved, and consider the question of penalty.

"It was urged that there was not in this case (as in the ferry and railway porters' cases) the circumstances that a board was actually at the time of the strike considering an award. That is true; but, on the other hand, there was an existing agreement which carried even greater weight than an award, for the very reason that it was an agreement. The men could have approached their employers or the Government, after the decision of the Court, without striking. But they preferred to tear up their agreement. Then the consequences were most serious. The strike was successful, and I cannot doubt was thereby the direct parent of the ferry and railway porters' strikes.

"Can I deal with those who set the example, and who had been threatening the community for six months, less severely than those who followed the example? They taught the other strikers that to cause great inconvenience and damage to the community by stopping necessary services was a thing which they could compel the employers to reward instead of to punish; and the consequence was that in the two following strikes the public were seriously injured in the same way. The gas employees were thus, though the last to be prosecuted, the ringleaders in the recent industrial troubles; and I cannot see that their punishment should be any lighter than that of the other strikers. I therefore impose on Perkins a penalty of £10, and on each of the other 99 defendants a penalty of £8, with costs one guinea in each case. I direct that the amount of such penalties shall be a charge on any moneys which are now or which may hereafter be due to each such person from his present or future employer, including the Crown, for wages or in respect of work done; and that the employer be notified of such order."

Newspaper Comments on the Judgment.

Sydney Morning Herald.

The aftermath of the gas strike was seen yesterday [June 24] in the Industrial Court, where Mr. Justice Heydon found a number of defendants guilty of a breach of the Act, and fined them for their participation in the strike. Of course, it is not a pleasant part to rejoice at others' misfortunes, even if they be merited; but at the same time it is impossible not to confess to a feeling of satisfaction that the law has been vindicated. The gas strike put Sydney to enormous loss and inconvenience; and that its consequences were not even more serious than they were was simply a piece of good luck. What sympathy the public had for the grievances of the gas workers was forfeited when they repudiated their agreement with the Companies and took the law into their own hands. A strike is always a deplorable thing; but when it affects a public utility such as gas, workers should feel a special responsibility, and should be restrained from breaking the law, not merely by the fear of penalties, but also by the thought of the tremendous hardship to the community their action may involve. . . . The gas strike was declared in order to secure a Wages Board. Still it involved the repudiation of an agreement voluntarily undertaken, and as such was quite unpardonable. It exhibited the same reluctance to abide by a contract which is becoming so universal a tendency in modern unionism. To the "man in the street," no clearer case of guilt could have been made out; and Mr. Justice Heydon was able to take the same view upon legal grounds. He disposed of the contention that the strike was not a demand for increased wages, but for a board to determine wages. If such a plea were valid, it would mean that an industrial agreement such as existed between the Gas Companies and their employees would be deprived of any binding effect. In the same way, the argument that by the ultimate settlement of the strike the right to prosecute had been waived was also dismissed.

Sydney Daily Telegraph.

In his judgment in the case of the gas strikers, Mr. Justice Heydon had to demolish one very curious contention—viz., that, even if the law had been broken, no penalty could follow because the right to prosecute had been given up. The strikers were apparently induced to believe this by the agreement of the Company that there should be "no victimization," and the undertaking of the Government to treat their case as a special one. But if the right of the law to operate could be nullified in this manner, offences against it might be committed with impunity; for an agreement not to victimize one class of offender would hold equally good with any other class. It was not only the Gas Company whom the engineers of the conspiracy to lay the city in darkness injured. The general public were also involved; and it is for their protection mainly that the anti-strike laws exist. And though the Company might condone the act as far as it was concerned, this could not deprive the public of its remedy. Such remedy does not consist in the gratification of any vindictive feeling, which would mend nothing; but the enforcement of the law is requisite to show others what they may expect if they follow a similar course, whereby they may be deterred from doing so. The intention is not to "victimize" strikers who are willing to abandon their wrong-doing, but to prevent the public from being victimized by others who might be tempted to imitate their conduct. In this respect, anti-strike laws are precisely the same as other punitive laws, and should be administered in the same way. No one would contend that men who had conspired to do an unlawful act of any other description should go scot-free simply because they made it worth the while of their immediate victims to overlook the offence. The Crown, as the custodian of the public peace, cannot have its right to prosecute men caught red-handed in offences, from which the public are sufferers, taken away merely because someone has agreed that the offenders are not to be victimized if they cease their wrong-doing. And if the Government by its interference or its promises led the gas strikers to imagine that it had thereby disarmed the law, so much the worse for whomsoever gave them that impression and for the men who foolishly permitted themselves to be deceived thereby. The right of the representatives of an injured public to prosecute law-breakers is created by Act of Parliament, and no other power can annul it. Mr. Justice Heydon's decision, by making this clear, should help to rid the community of some of the meaningless cant about "victimization" which is heard whenever one particular class of law-breaker is threatened with having to take the consequence of its actions.

EDINBURGH AND LEITH GAS COMMISSIONERS.

Semi-Jubilee of the Acquisition of the Undertakings.

Twenty-five years have elapsed since the Edinburgh and Leith Gas Commissioners acquired the undertakings of the Edinburgh Gas Company and the Edinburgh and Leith Gas Company; and appropriate reference to the event was made at the semi-jubilee meeting of the Commissioners on Monday of last week, by Lord Provost INCHES, who presided. His remarks were as follows:

It will be twenty-five years on the 1st of August since the Edinburgh and Leith Corporations' Gas Commissioners finally took over the undertakings of the Edinburgh Gaslight Company and the Edinburgh and Leith Gaslight Company; so that to-day we are celebrating the semi-jubilee of that event, and it will be interesting to review briefly the changes which have taken place and the benefits which have accrued from that policy.

What led to the formation of the Gas Commission was the application to Parliament by the Edinburgh Gaslight Company in 1887 for a Bill to establish themselves as a statutory undertaking, with powers to raise money and construct new works. So that even at that early period those in charge foresaw that the area of the New Street works would be inadequate to meet the constantly growing demands of the future. There was also another Company with works at Baltic Street, Leith, known as the Edinburgh and Leith Gaslight Company, which supplied gas throughout Edinburgh as well as Leith, and with which the Edinburgh Gas Company were in keen competition. But about the same time an understanding had been come to between these Companies, with the object of reducing the rivalry and dividing-up the districts so as to avoid duplication of mains, services, meters, &c., with consequent saving to both parties. However, the Corporations of Edinburgh and Leith, foreseeing that this might lead to monopoly, and also with the object of acquiring the gas undertakings for the public benefit, opposed the Edinburgh Gas Company's Bill, and eventually came to terms with both Companies to purchase their works and plant.

The proposal met with considerable opposition locally; but the wisdom of the step seems to have been appreciated by a good majority of the councillors, who were able to secure sanction for what has since proved to be a most profitable acquisition to the gas-consuming public and an excellent investment. The Edinburgh and Leith Corporations therefore applied to Parliament in 1888, with due success, for powers to carry out the above project; and the Edinburgh and Leith Corporations' Gas Commissioners, consisting of certain members of the Town Councils of Edinburgh and Leith—twenty-three in all—took over the management of affairs on the 1st of August, 1888; the Engineers and other officials being continued in the service.

It is interesting to relate that since that date 107 members of the Edinburgh and Leith Town Councils, including Lord Provosts of Edinburgh and Provosts of Leith, have been elected and served, or are serving, as Commissioners—74 representing Edinburgh and 33 Leith. Of these, 50 are now deceased—35 from Edinburgh and 15 from Leith. Of the present Commissioners, Judge Stewart, of Edinburgh, has the longest service, having been elected in September, 1901; and Provost Smith, of Leith, comes next, having joined the Board in 1901.

The total cost of the undertakings acquired by the Commissioners, including the taking-over of the Corstorphine Gas-Works in 1895 and the acquisition of the undertaking of the Portobello Gas Company in 1896, along with the parliamentary expenses of the original Act, amounted to £1,091,605. Up to the close of the last financial year (May, 1913), a further sum of £1,182,292 had been expended, of which £847,167 represented the cost of the Granton works and site, and £335,124 was for general extensions of the system due to the gradual growth of the concern. Further, the amount of £630,872 has been provided during the past quarter of a century for the reduction of capital; this sum including the unexpended balances at the credit of the sinking funds account and the reserve fund.

In 1888, the price of gas was 3s. 6d. per 1000 cubic feet to ordinary consumers for both lighting and power; and at the present time it is 2s. 8d. for lighting and 2s. 3d. for power and trade purposes, with more liberal discounts than formerly. In addition, meter-rents have been abolished, equivalent to a further concession of about £10,000 per annum.

Since the gas supply has been in the hands of the public, the business has increased in connection with the manufacture of gas by 75 per cent., or from 1200 million cubic feet to 2096 million cubic feet per annum. It should be specially noted that the wages of the workmen in the period under review have been increased from 30s. 4d. to 40s. per week among the retort-house hands; the labourers' rates being raised during the same term from 21s. 3d. to 25s. 6d. Again, the workmen receive more generous treatment in the way of holidays, and have the benefits of the superannuation fund.

Attention should also be directed to the fact that electric lighting was introduced into Edinburgh in 1895—six years after the Commissioners took office—and into Leith in 1899; but, notwithstanding this keen competition, the Commissioners' business has steadily prospered.

In 1897, the necessity for the enlargement of the works at Edinburgh and Leith, and the construction of new works, was again brought prominently before the Commissioners by Mr. Herring, who had been appointed Engineer and Manager in that year, with the result that it was decided, after careful and exhaustive investigation and consideration, to construct entirely new works at Granton. In 1898, parliamentary authority was obtained, and shortly afterwards operations were begun. The first section of these works was opened in 1902, and gas manufacture commenced; and in 1906 the second section was completed and ready for work. Full descriptions of the new works and plant, cost of erection, and manufacture were prepared by Mr. Herring, the Chief Engineer, and distributed among the Commissioners; so it is not necessary here to enter into elaborate details and repetitions.*

* A complete account of the works, with illustrations, plates, and details of costs, is given by Mr. Herring in the large volume entitled "The Granton Gas-Works of the Edinburgh and Leith Corporations' Gas Commissioners: Their Construction and Equipment," published at the Offices of the "JOURNAL."—ED. J.G.L.

As you are all aware, the scheme was a formidable one; but the results have more than justified the courage then displayed, and the masterful way in which the Commissioners have dealt with the business from the start.

Provost MALCOLM SMITH, of Leith, supplementing the Lord Provost's statement, expressed regret that the purchase of the gas undertakings of Edinburgh, Leith, and Portobello had not been undertaken ten years earlier than it was. If this had been done, the cost to the public might have been less than it was. Sometimes the Commissioners were blamed for not reducing the price of gas; but it must be remembered that soon after they took the business in hand it was found that the works in Edinburgh, Leith, and Portobello were not only scattered but obsolete, and new ones had to be inaugurated. The works now, he believed, were the finest in Great Britain. Had they been able to sell the old works at a profit, they would have succeeded in reducing their capital indebtedness. But, unfortunately, this had been impossible at the time, though they hoped in the near future to dispose of the works at a price satisfactory to the Commission and to the community. Mr. Herring's work in connection with the new scheme was universally known and admired. They appreciated all he had done in this connection.

General Business of the Commission.

The preceding remarks were made at the close of the business on the *agenda*, which included various matters briefly indicated below.

Bailie LINDSAY, the Convener of the Works Committee, stated that the past financial year had been one of phenomenal success. The high-water line had been reached in the output of gas, and a very high mark had been attained in the amount of money recovered from residuals, owing principally to the great increase in the price obtained from coke.

The Commissioners endorsed a recommendation by the Works Committee that they could not make a contribution on behalf of the forthcoming National Gas Exhibition.

The LORD PROVOST said he had received an invitation to be present to support the Lord Mayor at the exhibition, and had intimated his intention of accepting it.

The report of the Engineer and Manager (Mr. A. Masterton) for the month of June showed that the quantity of gas made was 105,603,000 cubic feet, compared with 101,805,000 cubic feet in the corresponding month last year. The total number of cookers in use at the end of the month was 14,579, compared with 11,056 a year ago.

The Commissioners approved of certain recommendations made by the Works Committee, after hearing representatives of the National Union of Corporation Workers. One of their requirements was that an all-round increase of ½d. per hour should be given. The decision was come to in this connection that the Commissioners, having recently exhaustively reviewed all the conditions of work of the employees, could not again give consideration to the question. They were assured at the time that the employees were satisfied with the conditions as then adjusted; and they had every reason to believe that this was still the case.

ZÜRICH GAS UNDERTAKING.

Reports and Accounts for the Year 1912.

We have received from Herr A. Weiss, the Engineer and Manager of the Zürich Corporation Gas-Works, a copy of the report and accounts for the twelve months ended Nov. 30 last. The following is a summary of the contents.

The No. 1 bench of inclined retorts was replaced during the summer by six beds each of 18 vertical retorts. Work was started on the latter on Oct. 8 last. The waggon tipper and coal conveying plant attached to it, which were included in the plans, were not quite finished by the end of the year. A garage is being constructed for motor vehicles, and some necessary repaving has been done on the works in consequence of the adoption of motor transport. A second railway track will be laid from the Schlieren Station to the works in the ensuing year. Further steps are being taken to protect the gas-works from being flooded when the water rises in the River Limmat. New mains and supply pipes, from 1 inch to 12 inches in diameter, have been laid during the year to a length of 8540 yards. No. 1 retort-house now contains twenty-four settings of nine inclined retorts and six settings of eighteen verticals; while No. 2 retort-house contains ten settings of ten vertical retorts.

The total amount of coal carbonized in the year was 104,710 metric tonnes (about 103,035 tons), and of cannel 40 metric tonnes. The total make of gas was 35,952,400 cubic metres (about 1270 million cubic feet). The average make of gas per ton of coal carbonized was therefore 12,315 cubic feet, compared with 12,344 cubic feet in 1911. The make per ton of coal in the inclined retorts was 11,149 cubic feet; in the settings of ten vertical retorts, 14,159 cubic feet; and in the settings of eighteen vertical retorts, 12,652 cubic feet. The old vertical retorts were worked with steaming. The lower make obtained with the larger settings of verticals is due to the fact that they were not worked to their full productive capacity during the short time of 55 days between their completion and the close of the financial year, and that steam was not admitted. In normal working, the make will be nearly the same as with the settings of ten vertical retorts. Only German coal was carbonized throughout the year. The coal was bought for the year at a lower price than in 1911—viz., at an average cost of 25s. per ton delivered in the retort-house. The total production of gas represents an increase of 6·78 per cent. on that for 1911. The make of gas per man per shift is very much higher with the vertical than with the inclined retorts, and is greater with the settings of eighteen vertical retorts than with the original settings of ten.

There was an increase of 8·34 per cent. in the quantity of gas sold to private consumers. The gas consumed for public street lighting represents 8·36 per cent. of the output, and that consumed in public buildings 1·06 per cent. The gas unaccounted for is 3·42 per cent. of the

total. The consumption per head of the population, excluding unaccounted-for gas and gas consumed for public lighting, amounted to 5241 cubic feet, which is a considerable increase on the corresponding figure for the previous year. The gas supplied to districts outside the municipal boundary amounted to 5·68 per cent. of the total production.

The coke consumed as fuel under the inclined retort settings amounted to 14 per cent. by weight of the coal carbonized, and that consumed in the settings of verticals, with steaming, amounted to 15 per cent. The yields of bye-products stated in percentages by weight of the coal carbonized, were as follows: Coke, 71·46; real ammonia, 0·2332; tar, 6·52; retort scurf, 0·031; prussian blue, 0·055.

The yield of ammonia is appreciably higher than in the previous year. The consumption of anthracene oil in the naphthalene washers amounted to 2·36 oz. per 1000 cubic feet of gas washed. The sludge obtained from the cyanogen washers contained on the average 8·85 per cent. of prussian blue, and 6·8 per cent. of ammonia, corresponding with 0·78 oz. of cyanogen and 1·09 oz. of ammonia per 1000 cubic feet of gas treated. Westphalian coals yield more cyanogen than Saar coals, and the inclined retorts more than the verticals. The spent Lux material used in the purifiers contained on the average 54 per cent. of sulphur and 1·2 per cent. of prussian blue. The net calorific power of the gas supplied from the works averaged 521 B.Th.U. per cubic foot at 60° Fahr., 30 in., and saturated. The impurities in the gas as distributed averaged 4·81 grains of cyanogen, 0·075 grain of ammonia, and 11·8 grains of sulphur, per 100 cubic feet. The coal-testing plant was used for testing 33 samples of Saar coal, 11 samples of Westphalian, 10 of French, and 6 of English coal. The majority of the samples were tested for other works.

In the physical laboratory investigations were made of gas cooking appliances, partly for the Heating Committee of the Swiss Gas Association. A large number of photometric tests were made of low and high power lamps and of translucent refractory quartz glasses for inverted lamps. These glasses afforded a better lower hemispherical illumination than ordinary translucent glasses, owing to their reflecting action. The number of public gas-lamps was 7074, containing 9459 burners. The number of automatic lighting and extinguishing appliances in use with these lamps was 2308—an increase of 238 in the year. The consumption of mantles in the street-lamps averaged 6·4 per burner per annum, and of chimneys 2·6 per burner.

The accounts show a total net profit on the year's working of 1,629,016·37 frs. (about £65,160), which is a considerable increase on the net profit for the preceding year.

STOKE-UPON-TRENT GAS DEPARTMENT.

The Annual Accounts.

In the last number of the "JOURNAL," the results of the working of the Gas Department of the Stoke-upon-Trent Corporation in the year ended the 31st of March last were briefly stated. The accounts of the four undertakings constituting the department—Burslem, Stoke, Fenton, and Longton—as prepared by the Borough Treasurer and Accountant (Mr. Thomas Thompson) furnish the following particulars:

	Burslem.	Stoke.	Fenton.	Longton.
Revenue . . .	£29,643 ..	£20,651 ..	£14,351 ..	£25,005
Expenditure. .	22,103 ..	15,846 ..	10,970 ..	17,443
Gross profit .	£7,540 ..	£4,805 ..	£3,381 ..	£7,562
Do., per 1000 cubic feet of gas sold . .	8·45d. ..	8·13d. ..	7·73d. ..	10·53d.
Loan repayments and interest, do.	6·40d. ..	7·03d. ..	6·76d. ..	9·00d.
Net profit. .	2·27d. ..	1·24d. ..	1·33d. ..	1·84d.
Gas made per ton of coal, cubic feet. .	12,485 ..	13,047 ..	12,263 ..	13,016
Gas sold, do. .	11,271 ..	11,836 ..	11,315 ..	12,090
Gas unaccounted for, per cent.	7·98 ..	7·84 ..	6·94 ..	5·68

Alderman T. MITCHELL, the Chairman of the Gas Committee, in presenting their minutes at the last meeting of the Council, briefly reviewed the work of the department during the past year. He said that of the four undertakings Burslem and Stoke showed a decrease of gas sold, while Fenton and Longton had increased. The decrease was accounted for by the coal strike—particularly as regards the lessened output for motive power—and the introduction of high-pressure gas lighting at many of the large works. At one place alone in Burslem the quarterly account had been reduced by nearly a million cubic feet. The prepayment meter continued its popularity; and there was an aggregate increase of 1095 in the four districts. The make of gas and the quantity sold per ton in the four works had been well maintained and was considerably beyond the average. The gas unaccounted for was not unduly high, considering the colliery and marl workings; and every care was taken to keep the mains in good order. In some portions of the area, steel mains were used with very good results. The public were showing more and more their appreciation of gas for cooking and heating purposes; and it had been difficult to meet the demand. The four undertakings, after all expenditure and meeting loan repayments and sinking fund charges, resulted in a net profit as follows: Burslem, £1970, equal to 2·21d. per 1000 cubic feet of gas sold; Stoke, £728, equal to 1·24d.; Fenton, £579, equal to 1·35d.; Longton, £1320, equal to 1·81d. These figures showed an exceptionally successful year's working, notwithstanding the heavy advance in the price of materials used. Fortunately the great rise in the price of coal did not come into force until July and August; and the residuals, especially coke, kept up in value, and saved what looked like a debit balance all round. The prospect for 1913-14, with a further advance of 1s. 8d. per ton (making 5s. per ton increase in two years) on the present year's contract, and a corresponding advance in the price of all other materials used, would depend largely upon the price of coke. Tar and sulphate of ammonia had already fallen. The price of gas was 1s. 10d. per 1000 cubic feet for lighting, cooking, and heating, both by ordinary and slot meters, and from 1s. to 1s. 5d. for motive power. These prices were among the six lowest in the kingdom, and consequently the consumption, more particularly for cooking and heating, was increasing. The pressure given during the day is now greater than used to be given for the lighting hours; thus enabling the consumers to have an ample supply of gas for cooking, heating, and power purposes. The latter was becoming quite a feature. The Committee had engines from 0·5 H.P. up to 150 H.P. driven off the mains. High-pressure lighting was becoming very popular with manufacturers; and the guarantee of 50 to 60 candles per cubic foot of gas was such an advantage that quite a number of firms had already installed it with great satisfaction. In conclusion, Alderman Mitchell said the Committee felt that the gas-works had achieved excellent results, and compared favourably with any four corporate gas undertakings in the kingdom. There were no immediate extensions required; and every economy, consistent with proper maintenance, would be continued, and so avoid, if possible, raising the price of gas.

The minutes were approved.

BURNLEY CORPORATION GAS UNDERTAKING.

Engineer's Annual Report.

The Gas Engineer and Manager of the Burnley Corporation (Mr. John P. Leather) has presented to the Gas Committee his report on the working of the Gas Department in the year ended the 31st of March last. In the course of it he stated as follows.

The make of gas shows an increase of 35,835,000 cubic feet, or 4·58 per cent., on the previous year. In the twelve months ended March, 1912, the increase was 3·81 per cent. In the latter period, the quantity of gas made was 783,979,000 cubic feet; whereas in the former period it was 819,814,000 cubic feet—the gas sold being 678,140,757 cubic feet in 1911-12 and 712,616,327 cubic feet in 1912-13. The unaccounted-for gas has dropped from 5·08 to 4·09 per cent. There are now 2984 public lamps in use in the borough, being 80 more than were reported last year. These lamps were lighted 3794¾ hours, and consumed 58,184,600 cubic feet of gas. There were, in addition to these, 106 lamps lighted at the charge of outside authorities and private individuals, and consuming 1,364,400 cubic feet of gas during the year. The total amount receivable for gas sold by meter within and outside the borough was £78,920; but it was reduced by discounts and allowances to £76,591.

Of the 819,814,000 cubic feet of gas made during the year, 119,327,000 cubic feet, or 14·5 per cent., were carburetted water gas. For the production of coal gas, 63,605 tons of coal were used. The make of this gas therefore works out to 11,013 cubic feet per ton, compared with 11,249 cubic feet in the previous year. For the production of the carburetted water gas, 121,964 gallons of oil were employed, or 1·02 gallons per 1000 cubic feet, compared with 2·56 gallons per 1000 cubic feet before. The prices asked for gas oil last year were so high that it was deemed advisable to abstain from purchasing. It was consequently necessary to use a much larger quantity of coal—63,605 tons, compared with 48,976 tons in the year 1911-12. It was not possible, however, to make all the gas required without using the carburetted water-gas plant. With this plant gas of higher illuminating power than the coal gas is usually made; but with the small quantity of oil at disposal Mr. Leather had to use it sparingly—making gas of lower illuminating power. The average quality of the coal received during the year was decidedly inferior to that to which the Committee had been accustomed. The Burnley collieries being unable to meet all the demands, a quantity of coal was supplied from Yorkshire collieries, which resulted in a considerably decreased make of gas per ton. Just before Christmas, the coal in one of the stores heated-up badly, and a large quantity took fire or was partially carbonized in the store. This further contributed to the reduced make per ton shown on the year's working.

There was an increase of 58 in the ordinary meters, and of 490 in prepayment meters in use during the year. The total number of meters is now 27,837, of which 14,952, or 54 per cent., are of the prepayment class. The amount collected from the latter meters during the year was £29,598 17s. 3d., corresponding to 238,971,897 cubic feet of gas. The average number of these meters in use at one time was about 14,700; the average annual consumption per meter was therefore 16,250 cubic feet. Last year the average was only 15,770 cubic feet. There are 11,379 small breakfast cookers in use with prepayment meters. In the gas-stoves department, 93 cookers and 79 gas-fires were sold direct; and 699 cookers were fixed on the hire-purchase system during the year.

DEVONPORT GAS UNDERTAKING.

Among the recommendations which the Gas Committee submitted to the Devonport Town Council last Thursday was one to the effect that the appointment of the present works foreman be determined, and that he be re-engaged as ganger in the retort-house; and that Mr. Isaac Carr, the Consulting Engineer, be requested to recommend a suitable man as works foreman.

Alderman TOZER, in moving the adoption of the Committee's minutes, said he was pleased to state that improvements had taken place at the works; but the Committee were fully aware of the great responsibility which rested upon them if they were to bring affairs into such a condition that the adverse balance at the end of the last financial year was to be converted into a profit at the end of the present year. They were giving much time to the matter, and were unanimous in the decisions they had come to with a view to produce success. The change now recommended with reference to the foreman had been under consideration for a long time, and was necessary for various

reasons. At the request of the foreman, a special meeting of the Committee was held at which he appeared and made a full statement; the Committee then again discussed the matter, but saw no reason for altering their decision. If further improvements did not take place in the near future, the Committee were fully resolved that more serious changes would be made without delay. They began at the bottom, and were not afraid to go to the top.

The action of the Committee was approved without comment.

The subject of the working of the gas undertaking was discussed on Wednesday evening at a meeting of the Devonport Ratepayers' Association. The Secretary reported that he had forwarded to the Local Government Board a resolution passed at a previous meeting with reference to the management of the gas-works, and asking for an inquiry. The Board replied that the matter was not one in regard to which it possessed jurisdiction, and it was not empowered to direct the holding of such an inquiry. Mr. Rogers said the letter was very unsatisfactory. If it had been a question of a twopenny falsification of accounts, there would have been an inquiry quickly enough; while in this matter, involving thousands of pounds, the Board declared that they could not order one. He moved a resolution protesting against the attitude of the Board, and demanding an inquiry. Mr. W. H. Wakeham urged that they should go more thoroughly into the matter, and have good practical business men in the Council. Mr. Matthews considered that it was useless to demand an inquiry until they could collect reliable information. They knew that there was something wrong with the gas undertaking, and that an enormous amount of money was being spent with little or no profit; but they must have something definite. The resolution was carried practically unanimously.

BIRMINGHAM GAS-METER CONTRACTS.

A Discussion in the Council.

In connection with the consideration of the report of the Gas Committee at last Tuesday's meeting of the Birmingham City Council, a discussion took place on the subject of the meter contracts.

Mr. J. V. STEVENS declared that the Gas Department, in dealing with these contracts, had shown a preferential treatment to certain firms, and had resorted to "dodgery" and jobbery, involving the loss of a considerable sum to the city. He asked the Council to request the General Purposes Committee to institute an independent inquiry into the matter. Early in March last, Mr. R. S. Hilton, the Secretary of the Gas Department, consulted him (the speaker) with reference to a French patent meter. He afterwards inspected the meter at the Windsor Street works, and found that it had a semi-rotary valve, which appeared to be a very unsatisfactory arrangement. In his opinion, it would have broken down in a very short time. He pointed this out to the engineer and to the foreman meter labourer, who said it could be altered to the ordinary straight valve. Mr. Hilton and Mr. Foster reported favourably on the meter, and said that a straight valve would be used. He (Mr. Stevens) had doubts as to the validity of the patent, and was surprised to learn from Mr. Hilton that he had not seen the specification. Yet it was contemplated to place a contract for £36,000, and pay a royalty of 1s. 6d. per meter, without testing the validity of the patent. In the meantime, he himself secured a copy of the patent, and was strongly of opinion that it was not valid; and, as a safeguard, he had a clause inserted in the contract to the effect that it should be subject to the validity of the English patent. He charged the Gas Department with deliberate preferential treatment and with favouritism between the firms tendering for the meter contract. The tender was for 12,000 meters for three years; the contract to be given to the representative of the French patent was for 20,000 meters, and for five years. It was fair to assume that, had the other firms tendering had the opportunity to contract for 20,000 instead of 12,000 meters, their tender would have been lower, and that they would have had an opportunity, very likely, of getting the order. Further, the representative of the French meter was given facilities for correcting defects in the meter, whereas other firms had not the same opportunity. The meter was an untried meter; and he regarded it as a risky piece of business to place a large contract for gas-meters which had not been tried in practice. On June 23, a contract was placed for 12,000 meters. Since then additional contracts had been given out for 20,000 meters at a price below that of the meter submitted by the representative of the French firm. Had the English makers had the same opportunity as the French meter makers, they could have given equal satisfaction. He contended that the Gas Committee had thrown away £5250.

Sir HALLEWELL ROGERS, in replying, said the contracts for prepayment meters, which had been made for three years, having expired, new tenders were issued for the usual quantity of 4000 meters per annum, and the makers were asked to quote for one year's and three years' supply. This contract was for meters required for the normal growth of the department, and had nothing to do with the replacement of any existing meters. For these meters, all the makers, with the exception of three, quoted the same price, which clearly pointed to the fact, which he did not think was disputed, that the principal meter manufacturers in the city had formed a ring. Although they would not agree that the ring would keep prices up, that was generally the effect; and the fact remained that the prices quoted were higher than those paid in some other parts of the country. One firm, however, quoted for a new meter which, when tested at the Windsor Street works, passed double the quantity of gas with the same loss of pressure as the other meters tested. This meter, which was originally patented in France, was being guaranteed by the English manufacturers, who were a substantial firm, for a longer period than was usual in the meter trade. It had also passed the French test for registration, which was more stringent than the English; and as the price was the lowest, the Committee naturally accepted the tender on the specific condition that the meter should be manufactured in the city. Just prior to this time, negotiations were proceeding with several manufacturers, with a view to the gradual replacement of something like 75,000 three-light wet prepayment meters by five-light dry meters. The meter manufacturers with whom they were then doing business were asked to quote prices for the three-light wet meters to be discarded, and for the replacement of these by five-light dry meters. None of them offered to take more than 1000 of these; but an outside firm had offered to take a minimum of 20,000 meters at a price advantageous to the department. In the first place, the Committee proposed to vary the existing contract of 12,000, and make it 20,000 on the replacement basis. The net result of the Committee's action had been that, to all appearances, many of the manufacturers who previously agreed to submit the same price, sent in independent quotations, and the new prices represented a great saving to the Gas Department. They were getting lower prices, to the great advantage of Birmingham. He strongly resented the use of the words "dodgery" and jobbery, and he would welcome any inquiry, if the Council wished it.

The report of the Committee was adopted.

LONDON COUNTY COUNCIL AND GAS-TESTING.

Important Staff Changes.

At the Meeting of the London County Council last Tuesday, the General Purposes Committee presented a report setting forth the arrangements to be made for the future conduct of the work performed in the chemical and gas-testing department, consequent upon the retirement of Dr. Frank Clowes, the Chief Chemist, as already notified in the "JOURNAL."

The Deputy-Clerk of the Council had reported to the Committee at length as to the character of the work performed by, and the constitution of, the department; and, after careful inquiry and consideration of the advice given by the Chairmen of the Committees principally concerned, the Committee came to the conclusion that the department should be discontinued as a separate entity, and that the work hitherto devolving upon it should be distributed among the departments whose work is cognate thereto. They suggested that the photographic work should be transferred to the stores department, the gas-testing work to the public control department, and the remaining work to the public health department. The result of the proposed arrangement would be that the greater part of the work now done by the chemical department would be undertaken in the public health department. The Committee suggested that Mr. J. H. Coste, who has been for some years Chief Assistant in the chemical department, should be styled "Chemist" to the Board. Referring to him, they said: "He is a Fellow of the Institute of Chemistry, and holds a recognized position as a writer on analytical chemistry. He has also made gas-testing a special study, and is about to publish a book written by himself and another officer in the department (Mr. E. R. Andrews), on 'The Examination of Fuel.'"

The financial result of the Committee's proposals is the discontinuance of the position of head of the chemical and gas-testing department (£1100 a year), and the reduction of the staff by one assistant in the first class (£300 a year) and the two minor establishment assistants (15s. to 25s. a week each). On the other hand, some expenditure will be involved in the stores department, owing to the transfer thereto of the photographic work.

The Committee submitted a series of recommendations, among which were the following: That the chemical and gas-testing department be discontinued as from Oct. 1, 1913; that the photographic work performed in that department be carried out under the direction of the chief officer of stores; that the gas-testing work be carried out under the direction of the chief officer of the public control department; and that the work other than photographic and gas-testing be carried out under the direction of the Medical Officer of Health of the County of London. The Committee also submitted resolutions for the transfer of the members of the staff in the department to the other departments mentioned, as from the above-named date.

The reported was adopted.

QUALITY OF LONDON GAS LAST YEAR.

The following particulars in regard to the quality of the gas supplied by the Metropolitan Companies last year are furnished in the annual report of the London County Council which has recently been issued.

The average illuminating power, in standard sperm candles, and the average net calorific power, in calories per cubic foot, were—

	Ill. Power.	Cal. Power.
Gaslight and Coke Company	14·53	120·6
South Metropolitan Gas Company	15·46	127·7
Commercial Gas Company	14·89	122 0

The average amounts of sulphur, in grains per 100 cubic feet of gas, were—

Gaslight and Coke Company	34·8
South Metropolitan Gas Company	24·5
Commercial Gas Company	27·1

The number of days in which the deficiency in illuminating power equalled or exceeded half-a-candle was—

Gaslight and Coke Company	76
South Metropolitan Gas Company	3
Commercial Gas Company	2

Gas Displaces Oil for Workhouse Lighting.—The Strabane Board of Guardians have agreed to substitute gas for oil in the lighting of the workhouse. The Strabane Urban District Council had pressed the matter on them on the ground that gas was cheaper than oil, which had hitherto been used, and was by no means so dangerous, especially in an institution of the character of that in question.

TRALEE GAS UNDERTAKING.

The Gas Engineer and Manager of the Tralee Urban District Council (Mr. James E. Enright) has submitted the accounts of the Gas Department for the year ended the 31st of March. The quantity of coal carbonized was 2561 tons, and the make of gas amounted to 28,690,000 cubic feet, of which 27,499,600 cubic feet were accounted for. There was an increased make of gas of 1,334,000 cubic feet, notwithstanding that the quantity of coal used was less by 17 tons. The average make per ton was 11,202 cubic feet, compared with 10,611 cubic feet before; showing a higher yield of 591 cubic feet per ton. There was an increase in the amount of gas sold and accounted for of 1,326,600 cubic feet; leaving 1,190,400 cubic feet of gas, or a little over 4 per cent., unaccounted for, representing waste and leakages.

Turning to the accounts, the total revenue amounted to £6968, and the total expenditure to £4945, showing a gross balance of £2023. Out of this, capital charges for new mains, services, and prepayment meter and cooker installations, were paid for, as well as a sum of £507 for interest on the debenture stock; leaving a net balance of £869 in favour at the close of the year. As a result of the satisfactory year's working, the price of gas for engines, stoves, &c., has been reduced from 3s. 4d. to 2s. 11d. per 1000 cubic feet; and Mr. Enright's salary has been increased by £40 per annum.

UNPROFITABLE ELECTRIC LIGHTING AT LIMERICK.

At an inquiry held last Tuesday by Mr. A. D. Price, one of the Engineering Inspectors to the Local Government Board for Ireland, into an application by the Limerick Corporation for sanction to a oan of £9500 for the extension of the electric lighting plant,

Mr. *E. O'Toole*, the City Treasurer, in answer to a question by the Inspector, as to whether there was sufficient revenue to pay the charge on the loan, stated that, since the inception of the electric light system up to the 31st of March last, the rates had contributed £14,479 towards the loss sustained by the working of the undertaking. For the last financial year the rates gave £2000. The prices charged were 5d. per unit for lighting, and 3d. for motors, cookers, and heaters. There was a scale of discounts, ranging from 2½ to 20 per cent. The number of consumers in December last was 241, and there had since been an addition of 47. The capital value of the undertaking was £34,500.

Mr. *B. Thornhill*, the Electrical Engineer to the Corporation, calculated that on the present working there would be an increased revenue of £600 this year.

The INSPECTOR: £2000 a year is rather too great a drain upon the rates.

Alderman *P. O'Donovan* (the Mayor) admitted that it was, and that quite recently a member of the Council brought the Corporation into Court in reference to the annual loss—contending that non-consumers were paying for the privilege enjoyed by consumers, and that, to meet the loss, the rate per unit should be increased. The Judge decided against the Corporation; quashing the rate of 5d. levied for the purpose of counteracting the loss sustained. [See "JOURNAL" for June 10, p. 753.] The Corporation had obtained legal opinion on the decision; and they hoped to "come out on top." The estimated loss on this year's working was £700, which was very favourable compared with last year, and showed that, under the present management, the place would eventually pay. So far as he (the Mayor) was personally concerned, he would be satisfied with a loan of £3500 for a battery, balancer, and boosters; and he added that if they increased the price of current to 8d. per unit, they might bid good-bye to the electric lighting undertaking.

Mr. *A. Killen*, Assistant Town Clerk, said a division was taken in the Corporation with regard to the amount to be borrowed; but the majority favoured the larger sum.

MELLOR (DERBYSHIRE) WATER SUPPLY.

The inhabitants of Mellor, a picturesque and healthful district situated on the slopes of the hills beyond the Marple (Derbyshire) Valley, have for some time been complaining of the water supply to the neighbourhood, and, as a result, a meeting of ratepayers was recently held, when it was decided to call the attention of the Local Government Board to the matter, though one speaker pointed out that the Rural District Council were the proper authority to deal with it. The district is largely tenanted by Manchester commercial men, and is regarded as a desirable residential area. It appears that there is plenty of good water in the district for everybody; but the land belongs to two private owners. One has an apparently inexhaustible supply. That of the other has run out, and the little that has passed through the pipes for some weeks was described by the Chairman of an indignation meeting of property owners and the tenants upon the estate as consisting of "tadpoles, worms, and filth." Two years ago, when a similar state of things arose, the District Council obtained permission from the agent to attach pipes temporarily to a stream on the fortunate estate, the water of which simply runs to waste without being used by any householder. It sufficed for all immediate needs. This time permission has been refused except on terms which are so prohibitive that the Chairman of the District Council says there is no prospect of the Local Government Board allowing the Local Authority to accept them. At the meeting referred to, it was decided to explain to the Local Government Board the peculiar urgency of the situation, and to ask for special permission to enable the Council to assent at once to the extraordinary terms of the owner of the good water supply. It was also unanimously resolved to urge the District Council, after meeting temporary needs, to take measures "to secure an immediate and permanently adequate and pure supply of water for all local requirements."

LIVERPOOL CORPORATION WATER SUPPLY.

Annual Report of the Engineer.

We have received from the Water Engineer of the Liverpool Corporation (Mr. Joseph Parry, M.Inst.C.E.) his report for the year 1912. It furnishes the following information.

Mr. Parry begins by pointing out that the summer of 1912 was a great contrast to that of the preceding year. In 1911, the want of rain, especially in the month of July, caused a serious deficiency of water for domestic and trade supplies over a large part of the country, though, happily, in the Liverpool area the abundant resources of the Corporation fully met all the demands of the population. During the three summer months of June, July, and August, 1911, rain was recorded on the Rivington watershed on 38 days, and the total depth of rainfall was 8¾ inches; while in 1912 rain fell on 74 days, and the depth measured was 19·67 inches. On the Vyrnwy watershed during the same three months of 1911 rain was recorded on 33 days, and the total depth measured was 11½ inches, against, in 1912, rain on 67 days, and a depth of 21⅜ inches.

The mean temperature of the period was 62·3° in 1911 and 57·6° in 1912. For the whole of the twelve months the Rivington rainfall in 1912 was 14¾ per cent. higher than in 1911, and the Vyrnwy rainfall 15·3 per cent. higher than in 1911. The total rainfall of the past year was considerably above the average over a long period; and the rain of 1911 was just about an average fall. One result of a heavier rainfall and the greater number of wet days in 1912 would have been a diminution in the quantity of water consumed, as compared with the year 1911, if it had not been for the disturbing influence of a severe frost at the beginning of the year. Upwards of 2000 burst lead pipes were reported in a few days; and the total number notified to the office during and consequent upon the frost was 10,948—the number of iron street pipes burst being 61. The consumption of water in and around the city rose from 205 million gallons in the week before the frost to 272 million gallons—an increase of 67 million gallons, or 32 per cent.

The average quantity of water sent out per day from the Corporation works during last year was 36,736,000 gallons; and the estimated population supplied was 1,109,463. The corresponding figures for the year 1911 were: Quantity supplied per day, 35,294,000 gallons; population supplied, 1,098,864. The increased daily consumption in 1912 over 1911 was therefore 1,442,000 gallons per day. This increase was chiefly in domestic supplies and waste. The maximum quantity delivered in any one day was, in the winter season, 43,412,000 gallons, and in the summer season 38,528,000 gallons. The total volume of water distributed during the year from the works of the Corporation was 13,371,830,000 gallons, obtained as follows: From Vyrnwy, 7,681,675,000 gallons; from Rivington, 4,791,670,000 gallons; from wells, 898,485,000 gallons.

The number of new premises supplied with water in and around the city during the year was 1381. The number from which the water was cut off, chiefly in consequence of demolitions, was 954; leaving a net number of 427 additional water tenants. The number of tenants on the rent-roll of the department at the end of the year was 205,197.

Professor J. M. Beattie, reporting upon the water, says: "The quality of the water as supplied to Liverpool, as is shown on the tables of the monthly and daily examinations, demonstrates that its bacterial purity has been well maintained during 1912."

During the year ended the 30th of June last, which is convenient for recording the progress made with the afforestation work carried on in connection with the water undertaking, the number of trees planted in the Rivington area was 293,600—chiefly Corsican pines, spruce, sycamore, and beech.

After some particulars in regard to new works, the report furnishes the financial results of the working of the undertaking, the total capital expenditure on which up to Dec. 31 last had been £6,516,542. The revenue was £371,418, made up as follows: Domestic water-rents, £84,129; public water-rate, £102,619; trade and miscellaneous supplies, £105,582; shipping, £31,906; supplies in bulk to local authorities, £39,706; Chorley Water-Works, £7476. The expenditure was £375,699, comprising £79,560 for working expenses, £46,465 for rates and taxes, £206,965 for interest on capital, £35,038 for sinking funds, and £7671 for Chorley works—the last three figures, excluding Chorley,

Metropolitan Gas Company of Melbourne.—We learn from Messrs. John Terry and Co., the London Agents of the Metropolitan Gas Company of Melbourne, that they have received cable advice to the effect that the profits for the six months ended the 30th of June last were £100,005. A dividend of 6s. 6d. per share has been declared for the half year, a sum of £33.500 placed to the reserve fund, and a balance of £42,750 carried forward.

The Passing of the Lamp-Post.—In one of his chatty paragraphs under the heading of "Told After Shop Hours" in the "Ironmonger" for the 26th ult., "Bypasser" said: "The London County Council, I notice, are asking power from Parliament to substitute centrally suspended lamps either for electricity or gas for the present lamp standards. From the point of view of the illuminating engineer, central lighting has advantages over lights placed at the sides of thoroughfares in busy towns. But æsthetically the devices at present used for suspending lamps over the middle of roads are several degrees uglier than the posts they supplant, besides being rather suggestive of the arrangements in vogue when horn lanterns were the favourite method of making the darkness visible. Lamp-posts, though not usually regarded as things of beauty, are useful in more ways than one. The arms are convenient for exhibiting municipal and other notices; while the standards are often of much assistance to strayed revellers, besides serving to protect pedestrians occasionally from the attacks of skidding motor omnibuses. Most important point of all, their manufacture provides a lot of work for ironfounders; so that were they to be superseded another blow would be levelled at the castings trade. There are quite enough overhead wires in London already without adding to the number by the general adoption of central lighting."

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Edinburgh.—The interesting *résumé* of the affairs of the Gas Commissioners during the last 25 years given by the Lord Provost at the semi-jubilee meeting shows that over £2,250,000 has been expended upon the undertaking, and the price reduced during that time by 10d. per 1000 cubic feet. The manufacture of gas had also risen by 75 per cent.; while wages in the retort-house and among labourers had increased by about 25 per cent. Bailie Lindsay, in seconding the adoption of the accounts, said the past year had been one of phenomenal success, and the high-water mark had been reached in the output of gas and a very high price obtained for coke and other residuals.

Glasgow.—The Corporation are to spend about a quarter of a million in a new electricity generating station, and have been advised by Dr. Ferranti that, before proceeding, they should see what was being done in America in the matter of large units. It was decided, at the meeting of the Corporation on Thursday, to send the Convener (Bailie Smith) and the Engineer (Mr. Lackie) to examine the plant installed at New York and Chicago. The work is to be carried out entirely by Mr. Lackie and his staff, and no Consulting Engineer will be employed. At the meeting of the Electricity Committee, it was decided to make three important changes in the rates. The number of hours for the 3½d. per unit charge is reduced from 650 to 600; for heating—equivalent to 1000 hours per annum—the price is reduced from 1½d. to ¾d. per unit; and a special rate on the 800 hours maximum yearly scale has been lowered from 1d. to ¾d. The coal bill is £20,000 up; but the gross profits are £175,109. From this, however, the interest on loans and sinking fund and depreciation must be deducted; so that the surplus transferred to the reserve fund is only £7520. It is quite evident that, with a rising coal bill, the only reason the reductions indicated have been decided upon is that the Gas Department are obtaining all the heating business; and the only way for the electricity folk to get a footing in this connection is by materially reducing their price. But even with the prices now proposed they are still much dearer than the gas suppliers.

Coatbridge.—In view of the satisfactory results and the increase in the sales of gas and residual products during the half year ended June 30, the Directors of the Coatbridge Gas Company, at their meeting on Tuesday last, on the motion of the Chairman (Mr. James Johnston), seconded by the Vice-Chairman (Ex-Provost Sharp), unanimously resolved to declare interim dividends at the rate of 13 per cent. per annum on the original stock and $9\frac{1}{10}$ per cent. per annum on the three issues of £10 shares, less income-tax.

Loanhead.—At the meeting of the Gas Company, the Directors recommended a dividend of 6 per cent., which is the highest paid by the Company for some time. The recommendation was agreed to. The Chairman pointed out that the year's sales were the largest ever experienced, and that the alterations and extensions, arranged for to keep pace with this increase, were well forward, and would be ready for the winter's supply.

Penicuik.—Despite the increased price of all materials used in gas making, the Gas Company have had a very prosperous year, and could have paid as much as 18 per cent. if they had used all their profits. This result has been achieved under a reduced price of gas; and if the cost of coal had not again risen, they would have been able to still further reduce the price.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Aug.* 1.

Sulphate of Ammonia.

In the early part of the week, the market for this material continued to be rather depressed; but towards the end there was more interest displayed, and the tone hardened to a certain extent. Direct buyers have, however, remained somewhat apathetic, and the improved demand has emanated mainly from middlemen. The closing quotations are £12 16s. 3d. to £12 17s. 6d. per ton f.o.b. Hull, £12 17s. 6d. to £12 18s. 9d. per ton f.o.b. Liverpool, and £12 18s. 9d. to £13 per ton f.o.b. Leith. The forward position has also become firmer; and it is reported that £13 10s. per ton f.o.b. Leith has been realized by producers for January-June delivery in equal monthly quantities, though consumers refuse to pay this price.

Nitrate of Soda.

The market for this article has again advanced, and to-day's values are 10s. 7½d. per cwt. for ordinary quality, and 10s. 10½d. per cwt. for refined, on spot.

LONDON, *Aug.* 1.

Tar Products.

There is very little fresh of importance to report concerning the markets for tar products. Pitch is unaltered. Though there has been a fair amount of inquiry for the forward position, business is not possible owing to the fairly high prices being asked by the manufacturers. On the other hand, we still have reports of contracts having been made on the Continent at very reasonable prices. Benzols are fairly steady, though some resales are reported for the forward position at reasonable prices. Solvent and heavy naphthas keep very quiet. Creosote is fairly firm in London; but some country makes are reported to have been sold at reasonable prices. The slight improvement reported last week in crude carbolic has been maintained, and distillers are now very firm in their idea of value.

The average values during the week were: Tar, 25s. 3d. to 29s. 3d. Pitch, London, 41s. to 42s.; east coast, 40s. 6d. to 41s. 6d.; west coast, prices nominal, Manchester, 40s. to 43s.; Liverpool, 41s. to 43s.; Clyde, 41s. to 42s. Benzol, 90 per cent., naked, London, 1s. 0½d. to 1s. 1d.;

FACTS ABOUT FIRES.

THE

SINGLE ROW OF LONG UPRIGHT FUEL

AND THE

USE OF GAS AND AIR ADJUSTERS

were both INTRODUCED and POPULARIZED

BY WILSONS & MATHIESONS, LTD., IN 1905.

(See "JOURNAL" Nov. 7, 1905, pp. 374 & 404.)

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WILL AGAIN MAKE HISTORY.

North, 1s. to 1s. 0¼d.; 50-90 per cent., naked, London, 10d. to 10½d.; North, 10d. Toluol, naked, London, 11d. to 11½d.; North, 11d. to 11½d. Crude naphtha, in bulk, London, 5¼d. to 5⅜d.; North, 4⅜d. to 5d. Solvent naphtha, naked, London, 11d. to 11¼d.; North, 9½d. f.o.b. Heavy naphtha, naked, London, 11d. to 1s. f.o.b.; North, 10d. to 10½d. f.o.b. Creosote, in bulk, London, 3½d. to 3⅝d.; North, 2⅝d. to 3d. Heavy oils, in bulk, 3½d. to 3⅝d. Carbolic acid, casks included, 60 per cent., prompt, east and west coasts, 1s. 5d. Naphthalene, £5 to £9; salts, 50s. to 55s., bags included. Anthracene, "A" quality, 1½d. to 1¾d. per unit, packages included and delivered.

Sulphate of Ammonia.

Throughout the week there has been practically no business doing—in fact, the position has excited very little interest. Buyers are still holding off, and will not even pay a premium for the forward position. Quotations remain about the same. Outside London makes are £12 3s. 9d. to £12 5s.; Hull, £12 16s. 3d.; Liverpool, £12 17s. 6d.; Leith, £12 18s. 9d.; Middlesbrough, £12 16s. 3d.

COAL TRADE REPORTS.

Northern Coal Trade.

There is a good demand in the coal trade of the North; the production being a little reduced by local holidays, and the consumption showing some expansion. In the steam coal trade, best Northumbrians are steady at from 15s. 4½d. to 15s. 9d. per ton f.o.b.; second-class steams are about 13s. 3d.; and steam smalls are rather firmer at 8s. to 9s. 6d. There are full exports of steam coals, especially to Baltic ports. In the gas coal trade, the deliveries on contract are increasing, and the output is well taken up. For best Durhams, the prompt quotation is about 15s. per ton f.o.b.; second-class gas coals are 13s. 6d. to 13s. 9d.; while for "Wear specials," the current quotation is from 15s. 6d. In a few instances, merchants are now offering gas coals for next year's delivery at rather lower prices, in expectation of lower freights. Such offers, however, are scarcely safe, for there is not much certainty as to the movement, either in the price of coals or in the rate of freights. Thus the value of coals delivered must be looked upon as very uncertain—at least, the winter months' gas coals promise to be in strong demand, and at firm prices. Coke is steady. Gas coke is being freely shipped from the Tyne; the current prices being from about 16s. 9d. to 17s. per ton f.o.b. in the river.

Scotch Coal Trade.

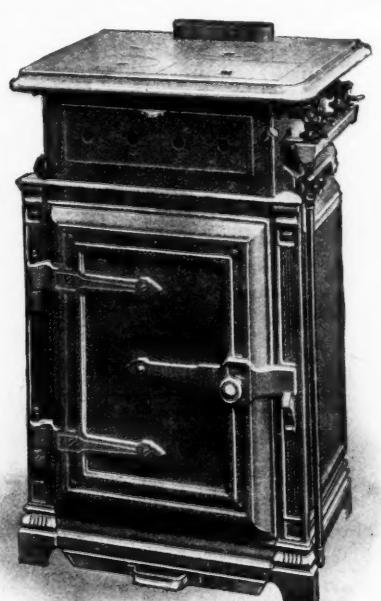
On the resumption of work at the pits after the holidays, the market opened with a strong demand, and prices ruled firm, especially for prompt loading. On the Glasgow Coal Exchange on Friday, the following were the approximate prices quoted f.o.b. Glasgow: Ell, best brands, 12s. 6d.; splint, 12s. 6d. to 15s.; Navigations, 15s. 6d. to 16s. 6d.; ordinary steam, 11s. to 12s.; Hartleys, 14s. 3d.; trebles, 12s.; doubles, 11s. 9d.; singles, 11s.; pearls, 10s. 6d.; dross, 8s.

Gas v. Electricity for Asylum Lighting.—The Management Committee of the County Mayo Lunatic Asylum have accepted the tender of the Castlebar Gas Company for a year's contract to supply gas to the institution at 4s. 10d. per 1000 cubic feet for lighting, 3s. 9d. for cooking, and 4s. 2d. for power. The Company had made an offer for a five-years' contract; but this was objected to, and the Chairman of the Committee suggested the postponement of the question of introducing electric light on the condition of a one-year contract, as stated. The Secretary of the Company had informed a member of the Committee that a one-year contract would involve too much expense.

The Test-Burner for Birmingham.—The proposal of the Birmingham Gas Committee, that application should be made to the Local Government Board for such amendment of the Local Act as would permit of the employment for testing purposes of the "Metropolitan" burner in place of the "London" argand, has been adopted by the City Council. It was pointed out that the Committee do not propose at the present time that any alteration should be asked for in the prescribed candle power, which is 15. Alderman Sir Hallewell Rogers said the effect of changing the test-burner would not be noticed by the consumers, though on existing prices the saving consequent on the alteration should represent about £10,000 per annum.

Gas-Stoves for the Latchmere Housing Estate.—At the meeting of the London County Council last Tuesday, sanction was given to the borrowing by the Battersea Borough Council of £875 for the purpose of supplying gas-stoves to their tenants on the Latchmere Estate. There are no gas-mains in the streets – the lighting of the estate being provided by the Borough Council's electricity undertaking; and, according to the proposed arrangement with the Council, the Gas Company will not be allowed to supply gas for lighting. For this reason, they require half the cost of the stoves to be met by the Council. The Company have agreed to accept payment of the £875 in five equal annual instalments; so that no money will be actually borrowed. As, however, the arrangement is in the nature of a loan, the consent of the County Council was required.

Water Supply and Health at Belfast.—The Belfast Rural District Council have adopted a report in reference to the question of the filtration of the water supply from the Whiteabbey district. The Local Government Board for Ireland had intimated that, in view of certain statements in the report of the Belfast Health Commission, it was the obvious duty of the Council to carry out the advice of their Consulting Engineers to provide filters. A Committee of the Council, in an interview with the Engineers, maintained that the extracts from the report were too limited, and that the actual facts as to the responsibility of the supply referred to, for the distribution of fever in the county borough of Belfast, should have satisfied the Local Government Board that there was no necessity for filters being introduced. The Engineers subsequently sent a report to the Committee, as a result of which it was now recommended that the Board should be requested to sanction a loan for additional mains and for enlarging and fencing the reservoirs.



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SHOW-ROOMS AND BRANCHES: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 56, Broad Street, BIRMINGHAM; 83, Old Market Street, BRISTOL; 13, Whitworth Street West, MANCHESTER; 8, Exchange Place, Donegall Street, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

Help for Electricity in Bristol.

A resolution has been carried without dissent in the Bristol Town Council to the effect that the Electrical Committee be requested to consider, with other Committees interested, the advisability of substituting electricity for gas where the latter is now used in buildings owned or controlled by the Corporation; to take such action as may be agreed upon, and to report to the Council thereon. The resolution was moved by Mr. Gane, who urged that the Council were paying enormous sums for gas, and said it seemed somewhat paradoxical that the Corporation should own the electrical concern, spend a lot of money in advertising, and yet be the biggest customer of the Gas Company. If they were to dispense with some of the gas they now consumed, and substitute for it electricity, the Corporation might, by generating more, supply customers at a cheaper rate.

Street Lighting at Hammersmith.

In order to substitute electricity generated at their own station, for gas supplied by the Brentford Gas Company for public lighting in certain streets in the town, the Hammersmith Borough Council have resorted to an expedient which will result in an ultimate loss to the ratepayers. At the meeting last Wednesday, the Works Committee recommended the alteration from gas to electricity of public lamps in certain streets in the borough along which low-pressure mains have been laid by the Electricity Department. They reported that they had approached the department with the object of obtaining a reduction in the charge per lamp per annum, in view of the lowering of the charge made by the Gas Company for public lighting since April, 1908. The present figure for gas is £2 6s. 10d. per lamp, or 7s. 2d. less than the rate charged by the Council's own department for electricity. The Electricity Committee were most accommodating. They agreed, in order to meet the Works Committee's suggestion, that the cost of converting the gas-lamps to electric lamps should be paid for out of the surplus profits of the Electricity Department, thereby reducing the Works Committee's cost by 7s. per annum, and making the sum equal to that paid for gas lighting. The reports of both Committees were adopted.

Fatality at the West Ham Gas-Works.—While some men were engaged, under a contractor, in painting a holder at the West Ham Gas-Works on Friday, one of the ropes supporting the staging on which they were working snapped, and three men fell to the ground. Two were killed outright, and the third died before reaching the hospital. In each case, the deceased had sustained fracture of the skull. At the time of the accident, a fourth man was on the staging, which had on one side a securely-fastened guide-rope from top to bottom of the holder. He felt a swaying, and seized the guide-rope; and when the snap came, he climbed on to a platform, from which he descended by a ladder to the ground.

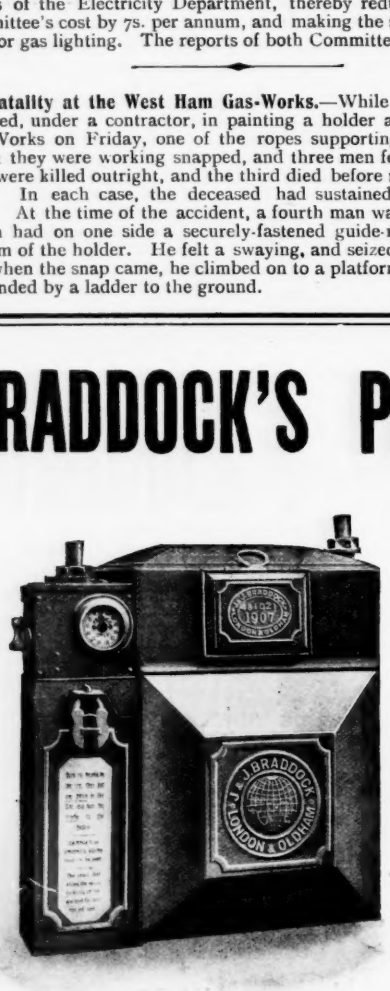
Cardiff Auditors and Rates-in-Aid.

The Cardiff Elective Auditors, in their annual report, referring to the various undertakings of the city, point out that the credit balance on net revenue account of the electricity works is £5962; and they see reasonable ground for hoping that the surpluses will increase from year to year. They add, however, that from the commencement of the electric lighting undertaking in 1894 to the present time a total sum of £63,171 has been contributed to the undertaking from the general district rate in the form of rates-in-aid; and during the same period there have been repayments to the district fund totalling £51,473. In order, therefore, that the district fund may eventually be fully repaid the sums provided through rates in previous years, it will be necessary for the electric lighting undertaking to contribute further amounts to a total of £11,698. Having regard to the credit balance of £5962 standing on the net revenue account, they say the Committee will doubtless be considering at an early date whether it might not be advisable to repay some proportion of the balance still outstanding. As to the water-works, the rate-in-aid for the past year amounted to £7529; the total sum received by the concern in this way since 1890 being £200,731. The only method they can see of obviating the necessity for these rates-in-aid would be by seeking parliamentary authority to increase the scale of charges, though there appears to them to be no advantage in adopting this course, as it would simply mean calling upon the ratepayers generally to pay the amount in another form.

Seville Water-Works Company, Limited.

The report which Mr. Cowley Lambert presented on behalf of the Directors to the shareholders of this Company last Thursday, showed further improvement; and the report and his speech combined indicated very markedly that the prospects of the concern realizing a large success have greatly increased by the present course of events. During the year ended March 31, the income amounted to £46,904. After deducting working expenses, the cost of laying on services and providing for debentures, the net profit for the year was £11,062, as compared with £9502 in the previous year. Adding to this sum the unappropriated profit at March 31, 1912—£4218—made the amount to the credit of profit and loss account £15,280. The Directors recommended a dividend of 3¾ per cent. on the share capital, free of income-tax, which will absorb £9664, and leave £5616 to be carried forward. The new filtered water project has been approved by the Municipality; but it is not possible to say when it will be finally approved by the authorities in Madrid. During the proceedings, both Directors and shareholders feelingly referred to the loss by the death of Mr. Easton Devonshire. He had been associated with the Company for many years; and all deeply deplored the loss of one whose intimate knowledge of the technical details of water-works management had been of such great value to the Company. The services of the Manager in Seville (Mr. J. J. Bithell) and his staff and of the Secretary in London (Mr. J. M. Hamilton) were referred to in very cordial terms.

BRADDOCK'S PATENT "SLOT" METERS



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THE BEST SLOTS MADE.

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Telegrams: "METRIQUE, LONDON." Telephone No. 2412 HOP.

Dublin Water Supply.—The construction of the new reservoir at Roundwood (co. Wicklow), in connection with the Vartry water supply to Dublin, is being resumed, after a stoppage of about two years. The works are fairly well advanced; the greater part of the large area having been excavated, and the tunnelling and other portions of the contract completed.

Torquay Water-Works.—Members of the Torquay Town Council recently paid their annual visit to the water-works, and made an inspection of their storage reservoir and other works. In the course of the speeches after luncheon, Alderman W. B. Smale, the Chairman of the Water Committee, stated that the filters were working very satisfactorily, and there were in store 40 or 50 million gallons more water than they had at this time last year. The waste had been reduced very considerably. The work of afforestation on the watershed was making steady progress. Planting was commenced in 1899, and since then £790 had been spent on trees and planting. The estimated value of the timber was now £1013, and it would continue to increase. Mr. S. C. Chapman, the Water Engineer, reckoned that the population in the area of water supply had increased from 48,790 in 1901 to 54,300 in 1911; and, including summer visitors, it was now fully 60,000. The increasing demands had been met out of the saving from waste. It was intended to defer the further expenditure of capital as long as possible. Thanks to their system of filtration, Torquay was second to no place in the matter of water supply.

At the Belfast Children's Court last week, a lad of fifteen was sent to a reformatory for four years for having on five different occasions, in various parts of the city, broken open gas-meters and stolen the contents. The money taken had been spent in "chips" and ice cream, and in going to music-halls and picture shows.

APPLICATIONS FOR LETTERS PATENT.

16,722.—TWEED, F. H., "Pipe connections." July 21.
16,745.—STOKES, F. W. S., "Compressor." July 21.
16,765.—SIRETT, F., "Acetylene generators." July 22.
16,790.—PEASE, E. L., "Cooling gas or superheating air, and interchange of heat between fluids generally." July 22.
16,871.—KING, J., BURNETT, J. R., and the RICHMOND GAS STOVE AND METER COMPANY, LIMITED, "Gas-heated furnaces." July 23.
16,874.—HODSON, R. E., "Measuring height of water in reservoirs." July 23.
16,910-1.—GLASGOW, A. G., "Process of burning solid fuel." July 23.
16,919.—COMPAGNIE POUR LA FABRICATION DES COMPTEURS ET METERIEL D'USINES À GAZ, "Counting or recording mechanism." July 23.
16,922-3.—ROS, D. DE, "Burners for liquid or gaseous fuel." July 23.
16,982.—PASCHER, F., "Pipe-joints." July 24.
17,019.—VULCAN-WERKE HAMBURG UND STETTIN AKT.-GES. "Gas-turbines." July 24.
17,022.—LAMPLE, J., "Gauges for gas-cocks." July 24.
17,042.—MACNAB, W., and BELL, T. L. G., "Production of sulphate of ammonia." July 25.
17,060.—TOMKINS, H., and KEMP, A. V., "Continuous regenerative gas-fired furnaces." July 25.
17,106.—KENT, W. G., "Liquid meters." July 25.
17,127.—HOLZAPFEL, A. C. A., "Obtaining tar from gas-producers." July 25.
17,170.—KEITH, J. & G., "Gas-lamps." July 26.
17,175.—KENT, W. G., "Liquid-meters." July 26.

GAS COMPANIES' STOCK AND SHARE LIST.

Last week was a short one for Stock Exchange purposes, the House being closed on Saturday. It might almost as well have been closed on the Friday too; for, with the final July account settled on the day before, and with no re-opening until the next Tuesday, anything approaching activity or a good attendance on the intervening day was scarcely to be hoped for. However, the week was not devoid of interest or of its good points, for the two chief bogies which had been affrighting markets—Balkan troubles and Rand troubles—were looking much less menacing at the close of it. The course of the settlement, too, aroused no misgivings, so far as at present discernible. Business on the whole has, naturally, been inactive; and this was at once apparent on the opening day. Still, the tone was fairly cheerful, and even improving as the day proceeded. Government issues were firm. Rails stood still at first, and then rose in recognition of support from buyers; and other leading departments showed strong points. On Tuesday, things were rather dull and inanimate; but markets in general gave no appearance of weakening. Fresh business on Wednesday was scarce, the settlement engrossing attention. The tone generally was only moderately good; but Consols had a rise of ¼ for account. Rails were devoid of feature, and almost of movement; and other lines moved unevenly. Thursday opened in cheerful mood on receipt of more encouraging intelligence regarding the Near East and South Africa; but even this could not quicken markets into enterprise, and business remained dead slow. However, markets held on pretty firmly, especially considering the lack of buyers. Friday was extremely quiet, and markets mostly were almost colourless. But the firmness of Government issues was marked by a rise of ⅛ in Consols, which closed at 73 to 73¼—a gain of ⅛ in the week. In the Money Market there was a demand for the month-end and for the Stock Exchange; but discount rates were inclined to abate. Business in the Gas Market was on a good scale, considering the advent of the holidays; and the tone was quite firm, though little actual change was marked. In Gaslight and Coke issues, the ordinary was fairly brisk, changing hands at the unaltered figures of 102⅜ to 103½. The secured issues realized 75¼ and 76¾ for the maximum, 96½ and 98 for the preference, and 73½ to 74 for the debenture. South Metropolitan changed hands at 110⅝ to 111¼, and ditto debenture made 72¼ to 73. In Commercials, the 4 per cent. realized 106 to 107, and the 3½ per cent. 102¾ to 103½. Among the Suburban and Provincial group, Alliance and Dublin was done at 67, Brentford old at 264½, ditto new at 202½ and 204, North Middlesex at 13¼, and Southampton at 103¼. In the Continental Companies, Imperial marked 162 to 163½, Union 80, ditto preference 124, and European 17 11/16. Among the undertakings of the remoter world, Hong Kong was dealt in at 17⅝ and 17½, Monte Video at 12⅜, Melbourne at 99½, Primitiva at 6, and ditto preference at 5 and 5⅛.

Issue.	Share.	When ex. Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,561,868	Stk.	April 11	5	Alliance & Dublin Ord.	66½–68½	..	7 6 0
374,000	,,	July 11	4	Do. 4 p.c. Deb.	80–83	..	4 16 5
280,000	5	April 11	7½	Bombay, Ltd.	6½–6⅝	..	5 11 1
50,000	10	Feb. 27	15	Bourne- 10 p.c.	28½–29½	..	5 1 8
832,000	10	,,	7	mouth Gas B 7 p.c.	15½–16	..	4 7 6
75,000	10	,,	6	and Water Pref. 6 p.c.	13¾–14¼	..	4 4 3
880,000	Stk.	Feb. 27	14	Brentford Consolidated	260–265	..	5 5 8
330,000	,,	,,	11	Do. New	200–205	..	5 7 4
50,000	,,	,,	5	Do. 5 p.c. Pref.	113–115	..	4 6 11
206,250	,,	June 13	4	Do. 4 p.c. Deb.	92–94	..	4 5 1
217,380	Stk.	Feb. 27	11	Brighton & Hove Orig.	206–211	..	5 4 3
244,200	,,	,,	8	Do. A Ord. Stk.	151–154	..	5 3 11
530,000	20	Mar. 28	12½	British	45–46	..	5 8 8
120,000	Stk.	June 27	4	Do. 4 p.c. Deb. Stk.	87–89	..	4 9 11
245,771	Stk.		4	Buenos Ayres 4 p.c. Deb.	83½–91½	..	4 7 5
100,000	10	,,	—	Cape Town & Dis., Ltd.	2–3	..	—
160,000	10	—	—	Do. 4½ p.c. Pref.	4–5	..	—
100,000	Stk.	June 27	4½	Do. 4½ p.c. Deb. Stk.	75–80	..	5 12 6
157,150	Stk.	Feb. 13	5	Chester 5 p.c. Ord.	109½–111½	..	4 9 8
1,513,280	Stk.	Feb. 27	5/9/4	Commercial 4 p.c. Stk.	105–107	..	5 2 1
660,000	,,	,,	5⅛	Do. 3½ p.c. do.	102–104	..	5 2 6
475,000	,,	June 13	3	Do. 3 p.c. Deb. Stk.	69–71	..	4 4 6
800,000	Stk.	,,	4	Continental Union, Ltd.	80–83	..	4 16 5
200,000	,,	,,	7	Do. 7 p.c. Pref.	124–126	..	5 11 1
492,270	Stk.	—	5⅞	Derby Con. Stk.	134–125	..	4 13 0
55,000	,,	—	4	Do. Deb. Stk.	103–105	..	3 16 2
1,002,180	10	July 30	10	European, Ltd.	17–18*	..	5 11 1
16,386,660	Stk.	Feb. 13	4/17/4	Gas- 4 p.c. Ord.	102–104	..	4 13 7
2,600,000	,,	,,	3½	light 3½ p.c. max.	75–78	..	4 9 9
4,062,235	,,	,,	4	and 4 p.c. Con. Pref.	95–98	..	4 1 8
4,674,850	,,	June 13	3	Coke 3 p.c. Con. Deb.	72–74	+½	4 1 1
258,740	Stk.	Mar. 13	5	Hastings & St. L. 3½ p.c.	89–91	..	5 9 11
82,500	,,	,,	6½	Do. do. 5 p.c.	—	..	—
70,000	10	April 25	11	Hongkong & China, Ltd.	17–17½	..	6 5 9
131,000	Stk.	Mar. 13	7⅛	Ilford A and C	153–155	..	4 18 4
65,780	,,	,,	6⅛	Do. B	120–122	..	5 0 5
65,500	,,	June 27	4	Do. 4 p.c. Deb.	87–89	..	4 9 11
4,940,000	Stk.	May 16	9	Imperial Continental	162–167	..	5 7 9
1,235,000	Stk.	Feb. 13	3⅛	Do. 3½ p.c. Deb. Red.	85–87	..	4 0 6
200,242	Stk.	Mar. 13	6	Lea Bridge Ord. 5 p.c.	121–124	+1	4 16 9
561,000	Stk.	Feb. 27	10	Liverpool United A	208½–210½	..	4 15 0
718,100	,,	,,	7	Do. B	147½–149½	–1½	4 13 8
306,083	,,	June 27	4	Do. Deb. Stk.	96–98	..	4 1 8
63,480	Stk.	June 27	3	Maidstone 3 p.c. Deb.	66½–68½	..	4 7 7
75,000	5	June 13	6	Malta & Mediterranean	4⅜–4¾	..	6 3 1
250,000	100	April 1	4½	Met. of Melbourne 4½ p.c. Deb.	98–100	..	4 10 0
541,920	20	May 30	4	Monte Video, Ltd.	12½–13	..	6 3 1
1,775,892	Stk.	July 30	4½	Newc'tle&G'tesh'd Con.	97–97½*	+½	4 12 4
529,705	Stk.	June 27	3½	Do. 3½ p.c. Deb.	83½–84½	..	4 2 10
55,940	10	Feb. 27	7/7/0	North Middlesex 7 p.c.	13–14	..	5 4 7
300,000	Stk.	May 16	8	Oriental, Ltd.	124–129	..	6 4 0
60,000	5	Mar. 28	10	Ottoman, Ltd.	8⅛–8¾	..	5 14 3
60,000	50	Feb. 27	13	Portsea, Island B	125–128	..	5 1 7
100,000	50	,,	12	Do. C	122–125	..	4 16 0
249,980	5	May 16	8	Primitiva Ord.	6⅜–6½	..	6 8 0
499,960	5	June 27	5	,, 5 p.c. Pref.	4⅜–5½	..	4 17 7
521,600	100	June 2	4	,, 4 p.c. Deb.	93–95	..	4 4 3
346,198	Stk.	June 27	4	River Plate 4 p.c. Deb.	90–92	..	4 7 0
275,000	5	Apl. 11	12	San Paulo, Ltd.	—	..	—
150,000	10	,,	6	Do. 6 p.c. Pref.	11¼–11⅝	..	5 2 2
125,000	50	July 1	5	Do. 5 p.c. Deb.	48–50	..	5 0 0
135,000	Stk.	Mar. 13	10	Sheffield A	225–227	..	4 8 1
209,984	,,	,,	10	Do. B	225–227	..	4 8 1
523,500	,,	,,	10	Do. C	224–226	..	4 8 6
90,000	10	May 30	7½	South African	9½–10½	..	7 2 10
6,429,895	Stk.	Feb. 13	5/9/4	South Met., 4 p.c. Ord.	109½–111½	..	4 18 0
1,895,445	,,	July 11	3	Do. 3 p.c. Deb.	71½–73½	..	4 1 8
209,830	Stk.	Feb. 27	8½	South Shields Con. Stk.	161–163	..	5 4 4
952,795	Stk.	Feb. 27	6	S'th Suburb'n Ord. 5 p.c.	117–119	..	5 0 10
60,000	,,	,,	5	Do. 5 p.c. Pref.	115–117	..	4 5 6
117,058	,,	June 27	5	Do. 5 p.c. Deb. Stk.	115–117	..	4 5 6
594,740	Stk.	May 16	5	Southampton Ord.	102–105	..	4 15 3
120,000	Stk.	Feb. 13	7¾†	Tottenham A 5 p.c.	139–142	..	5 3 10
543,940	,,	,,	5¾†	and B 3½ p.c.	115–117	..	5 0 5
149,470	,,	June 27	4	Edmonton 4 p.c. Deb.	90–92	..	4 7 0
182,380	10	,,	5	Tuscan, Ltd.	5–6	..	8 6 8
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	94–96	..	5 4 2
236,476	Stk.	Feb. 27	5	Tynemouth, 5 p.c. max.	114–115	..	4 6 11
				Wandsworth, Wimbledon, and Epsom—			
30,000	Stk.	..	..	Wandsworth A 5 p.c.	160–165	..	—
255,636	,,	..	..	,, B 3½ p.c.	132–137	..	—
108,075	,,	..	..	,, C 3½ p.c.	113–118	..	—
352,000	,,	..	..	Wimbledon 5 p.c.	110–115	..	—
98,000	,,	..	..	Epsom 5 p.c.	117–122	..	—
88,416	,,	June 27	3	3 p.c. Deb. Stk.	68–70	..	4 5 9

Prices marked * are "Ex-Div." † Next Dividend will be at this rate.

Tenders for the issue of about 700 ordinary £10 shares which were invited in the "JOURNAL" for the 1st ult. in the East Surrey Water Company, were recently opened at the Company's office. The issue was fully subscribed; the average price being £15 2s. 8d. per share.

In a special report on the prospects of electricity extensions in the course of the developments of the city of Bradford in the next decade, the City Electrical Engineer (Mr. Thomas Roles) foreshadows the use of coal gas instead of coal for firing the boilers at the generating station.

The Yorkshire Coking and Chemical Company, Limited, has been registered with a capital of £120,000, in £1 shares, to adopt an agreement between the Glass Houghton and Castleford Collieries, Limited (on behalf of the Company), and the Koppers Coke-Oven and Bye-Product Company, for the construction and completion of a coal-washing and coke-oven and bye-product plant at Glass Houghton, near Castleford, Yorks, and to carry on the business of colliery proprietors, coke manufacturers, tar distillers, oil producers and refiners, oil merchants, chemical manufacturers, &c.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

ENGINEER AND MANAGER. Abercarn Urban District Council. Applications by Aug. 12.

WORKS MANAGER AND CHEMIST (TAR DISTILLERS). No. 5773.

DISTRICT INSPECTOR OF COOKING AND HEATING APPARATUS (Shanghai). Applications to Mr. J. W. Mackay, 14, Re iston Road, Hornsey.

FOREMAN (GAS-WORKS). Applications by Aug. 9 to No. 5768.

TRAVELLER. Lowen, Hartridge, and Co., 36, Aldersgate Street, E.C.

STOKER. King's Lynn Gas-Works.

Appointments, &c., Wanted.

SECRETARY AND GENERAL MANAGER. No. 5763.

CHEMICAL PLUMBER. Davies, Galloway Road, Shepherd's Bush, W.

MANAGER (Home or Abroad). No. 5772.

Plant, Books, &c. (Second-Hand), for Sale.

GASHOLDER, &c. J. J. Simpson, Perth.

GASHOLDER. Luton Gas-Works.

"JOURNAL" VOLUMES AND GAS TEXT-BOOKS. No. 5766.

Meetings.

BRIGHTON AND HOVE GAS COMPANY. 5, Great Winchester Street, E.C. Aug. 22. Two o'clock.

CHICHESTER GAS COMPANY. Gas-Works. Aug. 26. One o'clock.

IRISH ASSOCIATION OF GAS MANAGERS. City Hall, Belfast. Aug. 12.

NORTH MIDDLESEX GAS COMPANY. 5, Great Winchester Street. Aug. 25. Two o'clock.

SOUTHGATE GAS COMPANY. 5, Great Winchester Street, E.C. Aug. 28. 3.45 o'clock.

TENDERS FOR

Boilers, &c.

CLECKHEATON GAS DEPARTMENT. Tenders by Aug. 20.

Capstan, Bollards, &c.

CLECKHEATON GAS DEPARTMENT. Tenders by Aug. 20.

Coal.

LYMM URBAN DISTRICT COUNCIL. Tenders by Aug. 20.

STRATFORD-ON-AVON GAS DEPARTMENT. Tenders by Aug. 9.

TRALEE GAS DEPARTMENT. Tenders by Aug. 31.

Fire Clay Goods.

SHEFFIELD GAS COMPANY. Tenders by Aug. 26.

General Stores (Sulphuric Acid, Tinned Ware).

DEWSBURY GAS DEPARTMENT. Tenders by Aug. 16.

HEYWOOD GAS DEPARTMENT. Tenders by Aug. 19.

Governor.

CLECKHEATON GAS DEPARTMENT. Tenders by Aug. 20.

Meters.

CLECKHEATON GAS DEPARTMENT. Tenders by Aug. 20.

DEWSBURY GAS DEPARTMENT. Tenders by Aug. 16.

Pipes, &c.

DEWSBURY GAS DEPARTMENT. Tenders by Aug. 16.

HEYWOOD GAS DEPARTMENT. Tenders by Aug 19.

Purifiers, Exhausters and Engines, Washers, Scrubbers, Condensers, &c.

CLECKHEATON GAS DEPARTMENT. Tenders by Aug. 20.

TRALEE GAS DEPARTMENT (EXHAUSTER). Tenders by Aug. 31.

Roofs, Steel Structures, Tank, &c.

CLECKHEATON GAS DEPARTMENT. Tenders by Aug. 20.

Tar.

AUDLEY URBAN DISTRICT COUNCIL. Tenders by Aug. 19.

HEYWOOD GAS DEPARTMENT. Tenders by Aug. 19.

LYMM URBAN DISTRICT COUNCIL. Tenders by Aug. 20.

Weighbridges.

CLECKHEATON GAS DEPARTMENT. Tenders by Aug. 20.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

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See Illustrated Advertisement, July 29, p. 336.

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